FOOD AND HYGIENE

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AN ELEMENTARY TREATISE UPON

Dietetics and Hygienic Treatment

BY

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PREFACE

THE Degeneration of the Race has been much talked and written about in recent years. Undoubtedly one of the most important methods of building up the Race and of checking deterioration is by due attention to the Food of the people. Especially important is the food of infants and children. It needs no defence when one asserts that deterioration may begin in the cradle, and that the proper establishment of a sound constitution should be begun there. Of no less importance is the dietetic and hygienic treatment of all people whose health is broken down and whose constitution is undermined by disease. It behoves the medical practitioner, as well as the patient, to give quite as much attention to these points in the treatment of disease as to the choice and administration of drugs.

In this volume an attempt is made to give an account of the most particular points in connection with food, air, and water, which are of interest to the patient or medical practitioner. The composition and character of the foods is given from many sources; that of the medicinal waters and the particulars about climates chiefly from the official reports issued from the respective health resorts. The introductory chapters give a résumé of the proximate principles in food and their digestion and assimilation. The food required by healthy persons at various ages and under different circumstances is also considered. I have

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PART I

CHAPTER I

INTRODUCTION

VERY few of our foods are now used in their natural condition; they have been so much altered by art and cultivation that their appearance, properties, and qualities bear but little relationship to the stock from which they were derived. How great, for instance, has been the influence of the breeder upon our animal food! By due selection of animals, by careful attention to feeding and other matters, an almost endless variety of cattle, sheep, pigs, rabbits, poultry and other birds, has been produced from their original stock. When we glance at the vegetable kingdom, we see even greater changes have taken place in the members thereof. The present varieties of wheat, oats, barley, rye, and rice, do not grow naturally, but have been developed by man from the original grasses to which they belong, by long application to the study of special kinds and by great industry through many centuries, to the present valuable and productive varieties. The potato, which provides food for millions of human beings, derives its origin from a small bitter root which grows wild in a few places in South America, as Chili and Monte Video. The common colewort, with its scanty leaves, weighing only a few ounces, has been artificially developed until it has become a cabbage whose leaves alone weigh several pounds, and its flower, which originally only weighed a few grains, into a cauli-

flower of as many pounds. In a similar manner the *Apium graveolens*, which in its wild state is acrid and unpleasant, has been transformed into the succulent and delicious celery. Peas, kidney-beans, onions, cucumbers, and many other vegetables, equally acknowledge the power of man to evolve transcendent qualities from simple forms by great care in selection and cultivation. When we look over our list of fruit the same unremitting attention has led to similar results : witness the transformation of the wild crab of the woods into our juicy cooking and delicious dessert apples ; the conversion of the sour sloe into the soft and melting flesh of the plums. The same influence has been extended over the grapes, the pears, damsons, peaches, pine-apples, oranges, lemons, currants, until, from a comparatively few simple forms growing wild in their native clime, an endless variety of fruit and vegetables has been produced, having the beautiful forms and perfect qualities now exhibited.

Man is an omnivorous animal, and can live equally well on an animal or vegetable diet, or a mixture of both. Many savage tribes exist almost entirely upon fruit and roots. The natives of Hindustan feed chiefly on rice, fruit, vegetables, and milk ; the peasants of Lombardy and other districts largely on maize ; West Indian negroes fatten on sugar, those of Senegal on gum ; more civilized people live on a combination of animal and vegetable food ; while the Laplanders, the Esquimaux, and other inhabitants of the frigid zone, live entirely on the fat and flesh of seal and other animals and fish.

Although man may subsist upon any variety of food, he cannot bear with impunity a sudden transition from one class to another. This has been exemplified again and again in times of scarcity, when only animal or vegetable food could be had. Animals of all kinds may be brought to live upon food exactly opposite to the natural aliment of their class, providing the change be gradually induced : thus, pigeons have lived on flesh, horses on fish, eagles on bread. Man can derive his food from any division of the organic world independently of the character of the aliment, and, providing it contains the proximate principles called proteid, carbohydrate, and hydrocarbon, and enters the stomach sufficiently bruised and divided, it will be acted upon by the digestive ferments and the nutriment extracted. Every kind of food is

assimilated and converted into flesh and blood, and yields heat and force for working the machinery of the body.

Conditions of time and place undoubtedly influence the variety of food most suited to man's organization. It is true that man can derive his food equally well from the animal as the vegetable kingdom, from raw or cooked material; that the ultimate effect of all aliments appears to be the same; and that foods differ only in the proportion of proximate principles which they contain. Nevertheless, it is equally true and for man's benefit that the kind and amount of food to be taken is governed by the circumstances of climate, season, exercise, occupation, habits, age, and individual peculiarities. Thus, as fruit and vegetables abound in the hot central regions of the earth and are deficient in the rigorous northern or frigid zone, so are we taught by this natural distribution that cooling fruit and non-stimulating vegetables are best adapted for the food of man in hot countries and in the summer season of temperate climates, and animal and other stimulating foods are better for us in the winter season, and always in the cold northerly climates of the globe. This natural suggestion is borne out by experience, for the inhabitants of hot countries—the Brahmins of India, the people of South America, of Africa, of the Canary Islands, of the other tropical inlands and the southern archipelago—live almost entirely on fruit, herbage, grain, roots and their produce; while the Esquimaux gluts himself with the blubber of the seal and other animal food. The natives of the temperate regions are enabled to indulge in a much greater variety of food, both animal and vegetable, and are consequently endowed with greater bodily and mental powers; indeed, a greater degree of bodily and mental activity, or laborious work, by an individual demands a more nutritious and stimulating diet, in which the superiority of animal food suggests a high place for it, which should not be overlooked in the adjustment of the proportions of animal and vegetable food. A sedentary occupation, on the other hand, necessitates less animal food; indeed, such individuals become oppressed, languid, subject to diseases of the liver, gastric catarrh, headache, and many ailments associated with the production of uric acid and its allies, if they take an excess of animal food. With regard to place of residence, it is a well-known fact that people who live in large towns and crowded cities suffer in

their health if they do not consume a fair proportion of fresh vegetables and fruit. Scurvy, which was formerly an exceedingly common ailment and caused a heavy mortality, is now comparatively unknown, because all classes of people eat more fruit and fresh vegetables than they did a century ago. But, while vegetables are necessary for the maintenance of health, they entail a larger amount of work on the digestive organs, and they are much less stimulating than meat; they are, indeed, when consumed alone, not sufficiently stimulating for the active exertions of the average individual of the temperate regions. On the other hand, an exclusive animal diet cannot safely be indulged in by the majority, for it is too highly stimulating, the springs of life are urged on too fast, and many diseases are a consequence of excessive animal food.

Age likewise influences the nature of the food demanded to some extent. Young children and growing youths thrive well on a generous diet of animal food. The young of all animals live entirely on animal matter in their first stage; even grain-eating birds live on the yolk of egg before they are hatched, and the young of mammalia are fed with the milk of their mother. So with children, animal matter in the form of milk is their natural food until they get their teeth; and it should not be omitted afterwards, for the development of their body is rapid, and any excess of animal matter is consumed in this important work. In the prime of life a man works best on a mixed diet containing a due proportion of meat and vegetables; but from middle life onwards, especially when active exertion becomes less and less a part of life's rôle, and as hard physical labour becomes a thing of the past, so should the food contain a comparatively smaller proportion of animal matter, until it arrives at the minimum which is necessary to sustain the vital processes, while the less stimulating carbohydrates are increased to a moderate extent to supply their place.

Care is required that the food we take is in quantity and quality proportioned to the bodily necessity, for upon that hinges the enjoyment of our health and spirits. Moderation in eating and drinking is one of the surest means of preserving or regaining health. As a matter of fact, persons usually take more than the actual requirements of the body, and the pleasures of the table

have been the means of bringing thousands to an untimely grave. It has been stated that more people die from excessive eating than from excessive drinking, and that the former excesses are more dangerous than the latter. It is true that excessive eating is as bad as excessive drinking, but not in the same way. It is equally true that very many people eat more food than they actually need; that in many cases the food is not properly proportioned, which thereby entails an undue amount of labour on the alimentary system and other portions of the economy to digest and dispose of it. On the other hand, moderation in eating and drinking is the surest way of preserving health and prolonging life to an advanced age. The persons who have been most remarkable for both have lived moderately, have taken their meals at long intervals, so as to give their digestive organs rest; at the same time, they have been quite as remarkable for their moderation in other matters—for their activity, equanimity of temper, and their regular mode of living.

It is absolutely necessary that *the food should be in a proper state for digestion*, and that the secretions it encounters in the alimentary canal are in a healthy condition and duly provoked by the presence of food. A *variety* of food pleases the palate and promotes appetite and digestion; but prolonged *monotony* of food, even of the best kinds, leads to satiety, to loss of appetite and relish and pleasure in it, and ultimately to loathing of such food, and consequent ill-health. A variety of food may therefore be considered absolutely necessary, just as much as good quality and the certainty of its containing a due proportion of the proximate principles required in the working of the machinery.

Excess of food, even if the digestive organs can convert it into absorbable and assimilable material, is in no way good for man. Excess usually leads to obesity and its attendant evils: excess of bread, starchy and sugary foods, produces acidity, flatulence, and indigestion; excess of meat and other proteid materials causes an accumulation of uric acid and its allies in the system, and leads to many diseases, such as gravel, gout, chronic rheumatism, diseases of the liver and other organs. If an excess of any kind of food is taken for a prolonged period, the stomach will not be able always to cope with it; putrefactive and other fermentative changes may take place in it, owing to the action of bacteria

normally present in the alimentary canal, and thus give rise to indigestion and flatulence, vomiting and diarrhœa, or gastro-enteric catarrh, or to various bacterial by-products belonging to the ptomaines and leucomaines, which, when absorbed into the blood, will cause fever, headache, fœtid breath, and disinclination for the duties and pleasures of life.

Deficiency of food can only be followed by evil results if it is long continued. Many are the wrecks of humanity caused by a period of semi-starvation, especially of proteid starvation, the result of having been compelled to live, as many poor but respectable people have been, for a prolonged period upon 'bread and tea,' because of the deficiency of proteids in these foods. Deficiency of proteid material results in a wasting and degeneration of all muscular and nervous tissues; and, even when it is ultimately sufficient, the individual does not always thoroughly recover, but is apt to remain neurotic and liable to many ailments. Continued deficiency in the amount of food causes loss of weight, anæmia, gastric disturbance, fever, debility, prostration, and ultimately death, unless relief is obtained. 'Fasting people' are very often frauds: they are fed by someone in collusion with them, especially when it is practised for gain or to attract sympathy; a similar remark applies to persons who are kept in a hypnotic trance for prolonged periods. But a person may live in a state of rest for five or six weeks without any food, providing plenty of water can be obtained; of course, anæmia, debility, and prostration will increase in proportion to its duration, and the final stages are similar to the 'typhoid state' which attends various illnesses of an asthenic character. Absence of either flesh-forming food alone or force-producing food alone can be borne for considerable periods, as in the case of proteid starvation. Thus, absence of meat from the diet is borne by many people for prolonged periods, because bread, the customary diet of the poor who are unable to obtain meat, contains 8 per cent. of proteid; likewise a deprivation of bread and other force-producing foods can be borne for prolonged periods, providing the person is well nourished at the commencement of the period or a plentiful share of fat exists in the meat diet.

CHAPTER II

THE CLASSIFICATION OF FOODS

MAN is an omnivorous animal, deriving his food from both the animal and vegetable kingdoms. Every quarter of the globe contributes its portion to the food of civilized man.

The elements which enter into the composition of the human body are precisely the same as those which compose the structure of the lower animals and the members of the vegetable kingdom. Like all other animals, human beings are unable to assimilate these elements in their inorganic condition—*i.e.*, they are unable to deal with the raw material; on the contrary, the principal elements required by them must be organized before they are of any use in their economy. For this reason a very important part of our food is derived from the animal kingdom; the animals derive their component elements from the vegetables which they consume; and the vegetables, in turn, derive them at first hand from the native sources in the earth, air, or water. This is necessarily so; such raw material as nitrogen cannot be assimilated by animals, but they must obtain this very important and indispensable element of life through the vegetable kingdom, either directly or indirectly; there is no other possible way to obtain it in a form adapted for their use. We are, therefore, ultimately thrown back upon the vegetable kingdom for our supply of nitrogen, without which life in any form is unknown to science.

The human system is composed of fifteen elements, the most important of which are carbon, hydrogen, oxygen, and nitrogen, which enter into the formation of nearly every structure in the body, and are estimated to form $\frac{29}{30}$ of the weight of the body. Some of the other elements are almost of equal importance, although a far less quantity of them is required: as phosphorus, for the brain, nerves, and bones; sulphur, for the hair, nails, and bile; iron, which gives the rich colour to the blood and secures, in loose combination with that fluid, the oxygen which is so necessary for the well-being of every tissue and so essential for the production of heat and energy in the body; sodium and

potassium exist in moderate amount in all the fluids; and calcium, magnesium, manganese, silicon, and fluorine, are combined with the other elements to give firmness and solidity to the bones and general framework.

The proportion of some of these elements in the body and required for daily use is fairly definite. Experiments have shown that the amount of carbonic acid gas exhaled daily from the body is equivalent to 5,000 grains of carbon, a solid mass of charcoal weighing 10 ounces. The amount of this element which is used up in vital and mechanical processes has to be replaced by food containing it; but there is no difficulty to supply it, because it exists in a greater or less proportion in food of all kinds: butter, fat meat, and oil contain more than half their weight of carbon; sugar, bread, starch, rice, and similar articles, rather less than half; and raw meat, game, fish, about one-seventh their weight of it. These are called hydrocarbon and carbohydrate materials, and are the medium through which carbon is obtained in a form suitable for human needs. Neither man nor animals can make use of charcoal or carbon in an unorganized state, and carbonic acid is a poison to them; carbon must therefore be taken in the form of a carbohydrate or hydrocarbon, which is the result of previous life in plants or animals. All animals derive it from plants, which alone have the power of taking up carbonic acid gas from the air and utilizing the carbon for the growth of their tissues and manufacture of their juices and nutritive compounds.

The amount of nitrogen required daily by human beings varies under certain circumstances, but it averages 300 grains for an adult. Our mechanism undergoes an unceasing change, owing to the wear and repair of the structures which consist mainly of nitrogenous elements; so persistently is this change going on that no part of the body remains the same after six or seven years, and the materials for the growth and repair of the tissues are derived from the proteids or flesh-forming principles in the food. All animals derive their nitrogen ultimately from plants, and the plants in turn obtain it from the soil, partly from ammonia and its salts, partly from nitrates and nitrites, and a little from the air.

The average daily loss of water through the lungs, skin, and

kidneys amounts to 80 ounces (4 pints); to make this loss good some portion of it is taken in the food we eat, and the remainder is usually consumed in various kinds of drink. Water forms about 58·5 per cent. of the entire weight of the body, and is therefore an exceedingly important constituent thereof. It is composed of hydrogen and oxygen, and is a principal means of introducing these elements into the system. It is the basis of all ordinary fluids, and its supply is derived from many sources, as plain water, mineral and aerated water, and through the medium of tea, coffee, milk, alcoholic beverages, and unfermented drinks. Some of the water which is excreted from the body is manufactured therein by various chemical processes, but chiefly in consequence of changes which take place in the structure of the body and in the food which is supplied to it; these changes are of a destructive character, and during their progress the proximate principles of the body and its food are reduced from high planes of chemical composition to lower and still lower grades, until they are finally reduced to carbonic acid, urea, and water. Hydrogen is derived by the body not only from the liquids we drink, but from all our solid food.

Oxygen is an element in the water we drink and the atmosphere we breathe, and is as essential for all our processes as nitrogen. An adult requires about 7,000 grains, or 15 ounces, daily; most of it is derived from the surrounding air, and the purity of the atmosphere largely influences our bodily activity and state of health.

The whole of the iron in the body only amounts to 46 grains, but it is a very important ingredient. The phosphorus required for the nerves and bones is also small in amount. Amongst other important inorganic substances in the body are potassium chloride, sodium chloride, phosphate and carbonate, and calcium carbonate and phosphate.

The elements which compose the living substance of the human body are arranged in more or less complex groups, which have an affinity for each other and bear a certain relationship. Even the non-living elements are chemically combined into groups, among which are some familiar forms, as water, sugar, starch, and common salt. Nitrogen is found in the body in substances composing our muscles, blood, nervous and con-

nective tissues; and the substances which contain it correspond with similar materials contained in our food. Carbon and hydrogen, which likewise exist in every living structure, are also found in similar combinations outside the human body, in substances which, when taken as food, produce energy—*e.g.*, glycogen, inosite, dextrose in liver, blood, and muscle, and in the form of fat and oil in animal and vegetable substances. This similarity in the grouping of elements in the body and the food has led to a classification of all substances which bear a like character, chemical relationship, or physiological use. A due consideration of these substances is a portion of chemistry and physics; for it is by the light of these sciences that we may learn the true composition and value of the foods required, that we may know which contain the proximate organic principles of like character and composition as those composing man's complex structure, and which will replace his worn-out tissues and provide his mechanism with energy for work and heat for warmth.

Foods are grouped together into the following four classes, according to their chemical composition and relationship and other characters which they possess:

I. **PROTEID OR NITROGENOUS FOODS.**—They are tissue-formers and force-producers; their main use is to maintain the structure of the body in good repair, but heat and energy are produced by changes which they undergo in chemical composition. Foods of this class are lean meat, flesh of birds, fish, eggs, milk, cheese; beef-tea, jelly; gluten of bread, beans, lentils, pea-flour, etc. This class of materials consist of carbon, hydrogen, nitrogen, oxygen, and sometimes sulphur or phosphorus. They are exceedingly complex in their nature and composition, and consist of the substances called **proteids**, which are mingled in various proportions, some in one kind of food, others in another kind. Aliments of this description are the only source of nitrogen for animals, because neither man nor animals can assimilate unorganized nitrogen or make use of it in their economy; they must obtain it from vegetables, or from animals which have lived upon vegetables. The chief proteids are:

1. Albumin or Albuminates.—(*a*) **Albumins**, such as egg-albumin, lact-albumin, and serum-albumin, are soluble in pure

water, are coagulated by heat and strong mineral acids; but they are not precipitated by alkalies, common salt, or very dilute acids.

(*b*) **Globulins**, such as **vitellin** in yolk of egg, **myosin** or muscle-albumin, **fibrinogen** and **paraglobulin** in blood. These are insoluble in pure water; but they are coagulated by heat, and they dissolve in a dilute solution of common salt; in dilute acids, which convert them into **acid-albumin**; also in solutions of alkalies, which convert them into **alkali albumin**.

(*c*) **Derived albumin**, which is not affected by heat—*e.g.*, casein in milk, also acid-albumin and alkali-albumin. They are insoluble in water and solutions of neutral salts, but are very soluble in dilute acids and alkalies.

(*d*) **Fibrin**, which is insoluble in water and weak solution of common salt; also gluten and several other insoluble proteids belonging to animals and plants.

Albumin, using the generic name, is widely distributed in animal foods of every description; it is met with in large quantity in muscle, liver, kidney, sweet-bread, brain, nerve tissues, and in the blood and lymph which form the normal juices of the same. Thus, white of egg contains $12\frac{1}{2}$ per cent. of albumin; the yolk has 3 per cent. of albumin, and 14 per cent. of casein; and raw lean beef contains 22 per cent. of albumin, of which 17 parts are digestible.

The vegetable proteids consist chiefly of albuminates, such as **gluten** in wheat; the vegetable casein or **legumin** in leguminous seeds, such as peas and beans; and **vegetable albumin** and **globulin** occur in the juices and seeds of many plants. **Aleuron**, which forms an important part of the nutriment in peas and beans and in other seeds and plants, is a mixture in the form of irregular grains composed of albumins and globulins.

Peptones and albumoses are proteids which have undergone chemical changes; they exist in germinating and other seeds; they are formed by the action of enzymes on other proteids, as in their digestion in the alimentary canal. They are soluble in pure water, but are not coagulated by heat, nor precipitated by acids, alkalies, or common salt, but are precipitated by nitric and tannic acids.

2. ALBUMINOIDS.—These substances occur in most animal and vegetable tissues, and are closely allied to the proteids, from which they are derived; the principal are:

Mucin, which is widely distributed as the cement substance of cells, and the ground-work of connective tissue. **Nuclein**, which is a substance similar to mucin, but contains abundance of phosphorus, and is found in all cells, and in milk and the yolk of egg. **Lecithin** also occurs in eggs and all nervous and other cellular tissues. Nuclein and lecithin are the forms of organized phosphorus in most animal substances. **Nucleo-albumins**, which are also abundant in cell protoplasm, are compounds of nuclein and globulin. Plastin, cerebrin, colloid, and the amides—leucin, tyrosin, and asparagin—belong to this group of albuminoids; also elastin, a substance in all elastic tissues; keratin, in the nails and other horny and epidermal tissues; chitin, spongin, and silk, which take the place of keratin in the invertebrates, are, like elastin and keratin, devoid of sulphur. The chlorophyll of plants is a nitrogenous substance. **Gelatine** closely resembles proteid, but differs from albumin in containing more nitrogen but less carbon and sulphur; some authorities say that it contains no sulphur. **Chrondrin**, which is closely allied to it, is a substance in all cartilages; like the former, it is dissolved out by boiling, and sets in a jelly on cooling. Gelatinous substances are contained in many animal tissues, as bone, tendon, ligament, connective, mucous, and dermal tissues, in the form of **collagen**. When these substances are boiled, they yield gelatine, which solidifies on cooling. Glue is impure gelatine. Isinglass is the purest gelatine, and is obtained from the swim-bladder of the sturgeon. A watery solution of gelatine is not coagulated by heat or mineral acids, but is precipitated by alcohol, tannic acid, and corrosive sublimate. It is converted by digestion into **gelatine-peptone**. Chrondrin differs from it in being precipitated by alum and vegetable acids.

The proteids are exceedingly complex nitrogenous bodies, which are essential to the existence of all living organisms. Taking albumin as the type, their composition may be represented by the following percentage of elements:

$$C 51{\cdot}5 \text{ to } 54{\cdot}5;\ H 6{\cdot}9 \text{ to } 7{\cdot}5;\ N 15{\cdot}2 \text{ to } 17;\ O 20{\cdot}9 \text{ to } 23{\cdot}5;\ S 0{\cdot}3 \text{ to } 2.$$

Their use in the animal economy is to assist in the manufacture of new tissues, to repair those worn out by wear and tear, and to

produce heat and energy by their chemical changes. They also add to the store of fat in the body, when more is consumed than is required for current expenditure. They undergo many changes in their constitution, and their ultimate destination is to be eliminated from the body in the form of urea, uric acid, carbonic acid, and water. They do not directly arrive at this low grade of composition, but pass through several intermediate stages. Some of these intermediate products are always in animal substances: such are creatin, creatinin, xanthin, hypoxanthin, sarcosin, sarcolactic acid, taurin, tyrosin, leucin, indol, skatol. These substances never enter, like the proteids from which they are derived, into the formation of animal tissues, but are the products of the disintegration of such tissues, and are called **extractives**; they enter largely into the composition of meat essences, beef-tea, gravy, broth, and similar articles of diet, and the flavour and odour of many kinds of animal food is due to their presence.

II. **CARBOHYDRATES.**—The carbohydrates are the great reserve of non-nitrogenous material in animals and plants; consequently, they form a large proportion of human food. Their use in the economy is to keep up the temperature of the body, and to supply the energy required for vital and muscular action; when consumed in excess of the bodily requirements, they form fat, and, especially in the young, materially assist in growth and development. There are three classes:

(*a*) Amyloses: $C_6H_{10}O_5$	Starch. Inulin. Cellulose. Dextrin. Glycogen.
(*b*) Sucroses or Saccharoses: $C_{12}H_{22}O_{11}$	Cane-sugar or sucrose. Malt-sugar or maltose. Milk-sugar or lactose.
(*c*) Glucoses: $C_6H_{12}O_6$	Grape-sugar or dextrose. Invert-sugar or levulose. Muscle-sugar or inosite. Galactose.

The carbohydrates are therefore another important class of substances; they form a large proportion of bread, potato, rice, sago, cornflour, arrowroot, oatmeal, sugar, fruit, and other kinds of

food. They are all closely related, and are chemically derivable (except inosite) from the normal alcohol, **mannite** ($C_6H_{14}O_6$). Mannite occurs in celery, onions, asparagus, fungi, in the gummy substances which exude from apple, pear, plum, and other trees, and is especially abundant in **manna**, which is formed from the juice of the ash (*Fraxinus excelsior*), which is exported as an article of commerce from Sicily, and used as a mild aperient.

Starch and cellulose are the most common carbohydrates. Starch consists of small granules, varying in size and shape in different vegetables, and is especially abundant in the roots and rhizomes of perennial plants, tubers, potatoes, seeds, grain, and legumes.

Inulin exists in solution in the cell-sap of many plants of the Compositæ and allied orders—in chicory, the tubers of dahlias, etc.

Cellulose forms the membranous walls of vegetable cells, and encloses the protoplasm, juices, and other contents. **Gum** and mucilage, which also belong to this group, are the secretion of vegetable glands.

Dextrin occurs in many vegetables through the action of an enzyme or ferment upon starch ; the latter is also converted by the enzyme, **diastase**, into sugar.

Glycogen is a carbohydrate stored up in the liver and other tissues of animals ; it is comparatively indiffusible, and is converted into **dextrose** for use in the body.

Inosite, a glucose, is one of the carbohydrates in the muscles of animals.

Cane-sugar or **sucrose** occurs in many plants ; it is the sweetening substance which is usually sold as ‘sugar,’ and is largely derived from the sugar-cane, beetroot, maple-tree, and other members of the vegetable kingdom. It is convertible into dextrose and levulose.

Malt-sugar or **maltose** is a product of the action of enzymes, like that of diastase on starch ; it occurs during the manufacture of malt from barley and other cereals, and during the digestion of foods containing starch.

Lactose is the sugar in milk, ‘milk-sugar.’ During digestion lactose is converted into **galactose**, which is classified with glucoses.

Grape-sugar (dextrose or glucose) occurs in very many vegetables

and in fruit. Grapes contain from 10 to 25 per cent. ; dried figs, 60 to 70 ; cherries, 11 ; mulberries, 9 ; currants, 6 ; whortleberries, 6 ; and raspberries, 4.

Invert-sugar is an uncrystallizable sugar occurring in vegetables and fruits—*e.g.*, plums, peaches, gooseberries, and many others —in conjunction with dextrose.

Fruit-sugar consists mainly of dextrose, and in some kinds—*e.g.*, dried raisins and prunes—it becomes gradually dried into a crystalline mass ; but in others the dextrose is converted by means of an enzyme into uncrystallizable invert-sugar or levulose.

Molasses or treacle is a product in the manufacture of domestic sugar, partly the result of the application of too much heat during concentration of the syrup ; it is a mixture of cane-sugar and levulose.

III. **HYDROCARBONS.**—This group consists of substances of an extremely varied nature ; they contain no nitrogen, scarcely any oxygen, and consist mainly of carbon and hydrogen so combined that they readily undergo oxidation, during which they give out a considerable amount of heat. It is the property of ready union with oxygen and consequent development of heat which renders them so exceedingly valuable as fuel for the animal economy. Hydrocarbons form the bulk of fat meat, butter, suet, oils, and other fatty substances. But other materials in our food also belong to this group—*e.g.* :

Alcohol, ethylic alcohol ($C_2H_5[OH]$), which occurs in small quantities in muscle and other organic substances, but is mainly the product of fermentation.

Amylic alcohol, also called fusel oil, is a common accompaniment of the above, when the sugar used for fermentation is derived from starch. Sugar of potato starch yields a large quantity, and it is commonly present in some kinds of whisky.

Allylic alcohol, under which heading is allyl-sulphocyanate, the chief constituent of oil of mustard and horse-radish.

Some of the hydrocarbons are most delicate substances, such as the fruit essences and flavours, which are ethers ; the volatile oils, which give odour, flavour, and pungency to many plants, flowers, and seeds, belong to the terpene series ; resins are oxidized products of the same series.

Fatty bodies exist in many cells of animals and plants, especially in animal fat, some vegetable seeds, and fruit. The most common are palmitin, olein, and stearin; and the most common fatty acids are palmitic, oleic, stearic, butyric, caproic, caprylic, rutic, and valeric; but there are others, and fat is formed by their union with glycerine. **Glycerine** ($C_3H_5[OH_3]$) is a trivalent alcohol, which is a product of the digestion of fat, and a by-product in the manufacture of soap. Fat is formed by a fatty-acid radical replacing the three hydroxyls in glycerine, thus: $C_3H_5(C_{15}H_{31}COO) =$ Palmitin. Stearin is abundant in hard fat; it is a stearoptene solid at ordinary temperatures. Olein exists abundantly in olive and other vegetable and animal oils; it melts at a lower temperature than either palmitin or stearin. A combination of these three substances forms the fat of animal tissues; and the olein and stearin are in such a proportion that the fat remains fluid at the temperature of the human body.

IV. **INORGANIC SUBSTANCES.**—The most important are water, oxygen, and salts.

The salts which we take in our food are numerous and of undoubted value; they form a considerable portion of the solid framework of the body, are necessary for all our secretions, and aid in the general metabolism. **Carbonates** are very common in nature; the carbonates of soda, potash, iron, and other minerals, render our blood and secretions alkaline, and assist in the digestion and elaboration of the food. Carbon is a substance widely distributed throughout the organic kingdom—everything which has life contains it; it is therefore a very important constituent of our food. Carbonic acid gas is one of the most important products of the disintegration of our tissues, and more than a very small proportion circulating in our blood and tissues is poisonous; its removal, therefore, becomes a matter of prime importance, and that is largely performed by the aid of alkaline carbonates, which take up the excess of carbonic acid from the blood and surrender it to the air in the lungs. The **phosphates** of lime, soda, potash, and magnesia, form a large part of the mineral substance of bone and other tissues and the secretions; and organic compounds of phosphorus enter into the composition of brain, nerves, muscle, blood, and the nuclei of other cells. Phosphates are in all our food, animals obtaining them chiefly

from the vegetables upon which they feed, and vegetables from the soil on which they grow. **Sulphates** and other compounds of sulphur are also found in variable quantity in nearly all living substances, and are of importance to mankind ; we derive our sulphur largely from the sulphates of soda, potash, lime, magnesia, and manganese. **Chlorine**, especially as chloride of soda and potash, is required for all human structures and secretions ; it occurs in very many of our foods. The human necessity for common salt, **chloride of sodium**, seems great ; it easily enters the system and quite as easily leaves it ; this necessity sometimes appears to be urgent, and wild or barbarous people have often had struggles to obtain it, in consequence of which the tax put upon salt in some countries is always a productive one. The **minerals** in combination with chlorine, carbonic, sulphuric, and phosphoric acids, are soda, potash, iron, lime, magnesia, manganese, silica, and fluorine ; and the total daily requirement of their salts is 360 grains.

Vegetable salts—formed by a combination of soda, potash, lime, and other substances with **organic acids**, acetic, citric, malic, tartaric, oxalic—are taken in most of our vegetable foods. **Citrates**, for instance, in the juices of the lemon, lime, gooseberry, strawberry, currant, cherry, and many other fruits and plants ; **acetates** also occur in certain vegetable juices, and in minute quantities in some animal fluids ; **malates** in apples, gooseberries, strawberries, and grapes, as a compound of malic acid and malate of potash ; **oxalates** in rhubarb, tomatoes, sorrel, spinach, beet, celery, plums, gooseberries, strawberries, raspberries, black tea, and pepper ; and **tartrates** and tartaric acid occur in the juice of many plants and fruits, and are especially abundant in grapes as cream of tartar. The organic salts consumed with the food are mostly transformed into alkaline carbonates in their course through the system, and usefully increase the alkalinity of the blood and secretions.

REFERENCES: Gamgee's 'Physiological Chemistry'; Watts' 'Dictionary of Chemistry'; Vine's 'Botany'; Attfield's 'Chemistry'; Halliburton's 'Physiology'; Power's 'Human Physiology'; Roscoe and Schlorlemmer's 'Chemistry.'

CHAPTER III

THE ASSIMILATION OF FOOD

The elements of which the body is composed are derived from our food by the processes of digestion and assimilation. Assimilation is the power which every living being possesses of taking foreign materials into its interior, and converting them into its own substance. By assimilation are made good those losses which arise from work and exercise; from the incessant activity of our brain, heart, and lungs; from the wear and tear of our organs; from the supply of heat and energy; from growth and reproduction of our species—all of which are common evidences of life. A brief outline will give some idea of the method of digestion and assimilation of the substances comprising an ordinary meal.

In its course through **the alimentary canal** the food is submitted to the action of various digestive secretions, which are fluids of a chemical character, and contain substances known as enzymes, or 'ferments.' The ferments require the presence of other ingredients in the fluid to aid them in their work, and each acts only on food belonging to a particular group or class; thus, one converts starch into sugar, another meat into peptone. The 'ferments' entirely change the character of our food, converting them from an insoluble colloidal material, which is incapable of being passed through the coats of the stomach and intestine, into soluble and crystallizable substances, which readily pass through and are absorbed. These fermentative and chemical actions are by no means simple. When we say that starch is converted into sugar and meat into peptone, we are not indicating a simple and direct process. On the contrary, our food passes through most intricate changes in its chemical composition before it arrives at the final condition which fits it for use in the economy. These changes can be watched outside the body by experiments which are extremely interesting.

Our food is, or should be, slowly bruised, finely divided, and reduced to a pulp by the teeth. During mastication it is moistened and mixed with the saliva, which assists in the process, and

administers to the sense of taste and the pleasure of eating. The quantity of saliva secreted is in proportion to the dryness of the food and thoroughness of mastication; by it the saline and saccharine constituents are dissolved. The most important change effected by the saliva is the conversion of the starch of the food. This it does by virtue of a diastatic ferment or enzyme called **ptyalin**, of which it contains $2\frac{1}{2}$ per cent., together with $\frac{1}{2}$ per cent. of sulphocyanate of potash. The starch is liquefied, and passes through various stages until it becomes **maltose**, a small quantity of **dextrose** also being produced. The bolus of food, having been thoroughly moistened and lubricated by the saliva, passes down the œsophagus into the stomach, where the diastatic action of the ptyalin continues for some time longer, until, in fact, it is destroyed by the action of the gastric juice.

The presence of food in the stomach stimulates the secretion of gastric juice, and causes the coats of this muscular receptacle to contract intermittently. The gastric juice is a fluid secretion containing 3 parts of pepsin and 2 parts of hydrochloric acid per 1,000, besides rennin and minute quantities of less important substances. The digestion of the proteid materials of the meal *begins* in the stomach; **the pepsin,** acting in an acid fluid, converts all kinds of albumin from being insoluble colloidal substances into soluble and crystallizable substances, which are readily absorbed into the blood. The conversion is first to acid-albumin, then hemi-albumin and pro-peptone, and finally peptone. As digestion proceeds the peptone is absorbed, and fresh pepsin and acid are secreted. Peptone passes through the coats of the stomach into the capillary bloodvessels of the same; these, uniting to form larger and larger branches, join with other tributaries of the **portal vein**, through which it reaches the liver. But peptone is not normally found in the blood, even in that of the portal vein, and the final changes still remain little understood, although it is presumed that peptone is converted into serum-albumin in its passage through the coats of the stomach and bowels, and only exists in the body under proper conditions as albuminates.

During digestion meat is quickly broken into fragments by the dissolution of its fibres, and is converted into peptone in about three hours. Mutton is more digestible than beef, while veal and pork digest slowly; lean meat digests quicker than fat, and the flesh

of young animals than that of old ones. Cooking softens most tissues and favours their digestion. Fibrous tissues, tendon and cartilage, are slowly digested in proportion to their firmness. Eggs and fish of the lighter kinds are digested in about an hour and a half; milk is quickly digested, being immediately coagulated by the **rennin** ferment, and its curd peptonized and absorbed. The gluten of bread and aleuron of peas and beans are also dissolved and peptonized. Starch is not acted upon by the gastric juice, but any dextrin which has been produced by the action of ptyalin upon it is now converted into dextrose and absorbed; cane-sugar is also converted into dextrose. The gastric juice, however, has no influence upon fats and oils, excepting that it dissolves the albuminous coverings of the cells, and thereby liberates the oil.

The digestion of an ordinary full meal occupies from four to five hours; but certain conditions interfere with this process. Thus, if an excess of food be taken it will only be imperfectly digested, and the products may set up irritation all along the alimentary canal. The presence of indigestible or unwholesome food causes an excessively acid secretion and consequent gastric derangement. Raw fruit, such as apples, candied-peel, nuts, raw turnip, carrot, and cheese, can only be eaten with impunity when plenty of exercise is taken; indeed, they are a frequent source of gastric troubles. Excess of sugar causes a secretion of much mucus, which acts injuriously by surrounding the particles of food, and thereby preventing the proper access of gastric juice to them, and likewise hinders the absorption of such food as is digested. Exercise during digestion, especially soon after a meal, will interfere with the process by withdrawing to the brain or muscles a portion of the blood which should be engaged in supplying the materials required for the digestive process; for this reason a proper period of rest is advisable, especially after a heavy meal. Fluids, such as water, beer, coffee, tea, are normally absorbed in a few minutes, or half an hour at the most, and by their removal they permit of the better mixture of the more solid portions of the food with the gastric juice. The presence of an excess of liquids, either taken with the meal or by drinking between the meals, has the effect of materially delaying the process of digestion.

All the food which is taken into the stomach does not pass through its coats into the circulation, but a considerable portion goes through the pyloric aperture of the stomach into the small intestine, where it is subjected to the influence of other ferments which are quite as active as those of the mouth and stomach. The semi-digested food which passes through the pylorus into the intestines is called **chyme**. It is a thin, creamy fluid, consisting of (*a*) the products of digestion up to the pylorus—viz., peptone, dextrose, levulose, and gelatine-peptone; (*b*) all matters which have been only partially digested by the salivary and gastric secretions, in a state of fine subdivision, as starch, partly digested meat, some forms of albumin, connective and elastic tissues; (*c*) substances unchanged by saliva or gastric juice, as fat, cellulose, and other vegetable matters; (*d*) fluids not previously absorbed. The really insoluble or indigestible residue of the food remains some time longer in the stomach, but is ultimately propelled through the relaxed pylorus.

When the chyme reaches the small intestines it is subjected to the influence of digestive ferments contained in the pancreatic fluid, the succus entericus, and the bile. The **bile**, secreted by the cells of the liver, is a fluid which passes into the intestines through the common duct of the liver and pancreas; it contains peculiar salts which assist in the absorption of fat, and it precipitates the proteids of the chyme, and thereby prepares them for the action of the pancreatic fluid, but it has little or no influence upon sugar or starch. Bile acts upon the fat of butter, cream, oil, meat, fish, by converting it into an **emulsion**, or very fine particles; and some portion of such fat is split up into glycerine and fatty acid, and the latter, combining with the alkaline salts of the bile and pancreatic fluid, becomes *saponified* or forms various kinds of soap, which readily pass into the lacteals and bloodvessels of the intestines, and finally reach the general circulation. The emulsified fat is also absorbed by the lacteals, and reaches the blood through the lymphatic vessels. The liver has other functions besides the secretion of bile: it is a reservoir of glycogen or carbohydrate material; it also produces urea and hæmoglobin, destroys blood cells which are worn out, and performs other functions which are less understood.

The mixing of the acid chyme with the bile in the intestines

causes a precipitation of the proteids contained in it, which, however, are again dissolved by the secretion of the pancreas. The **pancreatic juice** is the secretion of the pancreas or sweetbread, and reaches the bowel through the channel common to this organ and the liver. It contains several powerful enzymes or ferments—viz., **trypsin**, which converts proteids into peptone through several stages ; **amylopsin**, which transforms starch into sugar ; and **steapsin**, which saponifies fat and oil. Another secretion, called the **succus entericus**, from the glands in the coats of the intestines, also mingles with and assists in the digestion of the same constituents of the food, but in a lesser degree. The pancreatic fluid may be said to finish or complete the digestive process. Whatever starch is not converted into sugar by the salivary ferment, or albumin converted into peptone by pepsin, or fat emulsified and saponified by the bile, is transformed into sugar or peptone, or saponified by the enzymes of the pancreatic secretion ; and the product is called **chyle**, and from it the digested portions are absorbed.

Various changes in the appearance, consistence, and quantity of the material take place in its course along the alimentary canal. As it leaves the stomach, the chyme is a yellowish, creamy solution ; but in the duodenum it becomes thinner by being mixed with the bile, and its colour is changed to a greenish-gray. As it is propelled slowly along the intestines, some of the fluid and products of digestion are absorbed, and the mass attains a greater density. More and more nutriment and water are absorbed from it, even during its slow descent through the colon, where it becomes thicker and browner, and finally the innutritious and indigestible portion is rejected as fæces.

The **fæces**, as the dejecta are called, contain all that is indigestible or insoluble in the food, together with such secretions as have not been absorbed. The residue, or waste, from various foods differs somewhat. Thus, meat yields 5 per cent. of waste ; eggs, 5 ; milk, 9 ; peas, 9 ; beans, 15 ; bread, 4 ; potatoes, 11 ; rice, 4 ; macaroni, 4 ; maize, 7 ; starch from arrowroot or cornflour, about 1 ; and fat about 5, except when its consumption is excessive. With an ordinary diet, the fæces roughly represent one-seventh or one-eighth of the food, and consist of the following : (*a*) Indigestible portions of food, as

cellulose, chlorophyll, uncooked starch, gum, resin, mucin, nuclein, tendon, elastic fibres, keratin, chitin, and insoluble salts; (*b*) products of the decomposition of food, insoluble soaps, some fatty acids, etc.; (*c*) bile residue, cholesterin, lecithin, choletelin, stercobilin; (*d*) bacteria of many kinds, débris of intestinal matter; (*e*) other undigested food.

The *digestibility* of food depends upon several things, such as the form in which it is presented to the digestive secretions, the suitability of the food to provoke a flow of those secretions without unduly irritating the alimentary canal, and on the character of the food. The time occupied by digestion also varies. Boiled meat, fish, or fowl is more quickly digested than roasted flesh of the same animal. Thus, roast beef requires 3 to 4 hours; mutton, 3 to $3\frac{1}{2}$; lamb, $2\frac{1}{2}$; venison, $2\frac{1}{4}$; poultry, turkey, pheasant, 3 to $3\frac{1}{2}$; veal, $4\frac{1}{2}$; pork, 5; fried eggs, $3\frac{1}{2}$; boiled mutton, only 3 hours; beef, 3; poultry, $2\frac{1}{2}$ to 3; fish, $1\frac{1}{2}$ to $2\frac{1}{2}$; eggs, $2\frac{1}{2}$ to 3, according to hardness; raw eggs, $1\frac{1}{2}$; milk, $1\frac{1}{2}$ to 2; and tripe, 1 hour. Wheaten bread requires 3 to 4 hours; rice, sago, tapioca, or other milk pudding, $1\frac{1}{2}$ to 2; potatoes, parsnips, and beans, $2\frac{1}{2}$ to 3; cabbage, $3\frac{1}{2}$ to 4; carrots and turnips, $3\frac{1}{2}$ to 4; apples, 3 to 4; and cheese, 3 to 4. Meat consists of muscle, supported by connective tissue and fat. In the stomach the fat is liquefied; gelatine is dissolved, converted into gelatine-peptone, and absorbed; the muscular fibres of the lean meat fall apart, and are split into discs and sarcous elements, being thoroughly prepared for complete peptonization in the bowels. Meanwhile, some of the albumins and globulins are converted into peptone and parapeptone in the stomach, the peptones being thence absorbed into the blood; but the parapeptones pass with the chyme into the small intestines, where they are converted, through various stages, into antipeptone, and absorbed. Some of the nuclein of the cells is digested in the bowels and absorbed into the blood, the rest is rejected with the fæces, and elastic tissue also for the most part passes out of the body with other indigestible portions. The *fat* meat consists of a slight framework of gelatinous connective tissue, with blood and lymph vessels, enclosing large cells filled with a mixture of olein, palmitin, and stearin. During digestion in the stomach, the gastric juice dissolves the connective-tissue framework and the gelatinous

envelope and protoplasm of the cells, thereby liberating the liquefied fat, which is churned up with the other contents of the stomach, and passes with the chyme into the bowels, to be emulsified and saponified and absorbed by the lacteals and bloodvessels.

Much meat is indigestible. The flesh of very young animals—*e.g.*, veal—is harder of digestion than that of the full-grown animal; but from adult age onwards the flesh of all animals gets harder and tougher, and consequently more difficult to digest. Chicken, game, boiled fish, and tripe are easily digested, because they possess a fibre free from fat, and are therefore more readily acted upon by the gastric juice. Pork is indigestible because it contains a large quantity of fat, by which every muscle fibre becomes coated in the cooking. Ham, fat bacon, and other fat meat, are not so easily digested as poultry, not merely because the flesh of poultry is more tender, but because the former contain much more fat, which has to be removed before the digestive juices can act upon the muscle fibres. Fish holds an intermediate place as regards digestibility; but this, too, may be rendered indigestible when cooked in fat or served with highly-seasoned sauces. Sweet-bread is easily digested, because it consists of cells loosely held together by connective tissue, which is easily acted upon by the digestive ferments, and the cells fall apart and are quickly dissolved in the same. Meat extracts, clear soup, and similar articles, are, like water and alcohol, absorbed without any change. Milk, cheese, and butter have their proteids and fat digested in the same way as these substances in meat.

Bread is easier to digest than meat. Animal food easily provokes a flow of the digestive secretions, but makes a heavier demand on digestion than starchy and carbohydrate foods in general, and the elaboration and elimination of all proteids throws more work on the liver and kidneys than do carbohydrate and fat, whence the latter have an advantage over the former. Bread consists chiefly of starch and gluten. The starch is converted by the saliva and pancreatic fluids into sugar, which is readily absorbed into the blood; the gluten is peptonized in the stomach and bowels, like the proteids of meat; but the cellulose covering of the starch cells is very indigestible, and mostly passes

out of the bowels with other indigestible residue. In potatoes the starch cells or granules are burst by cooking, and the digestive ferments readily attack the starch and convert it to sugar. Arrowroot, cornflour, rice, sago, and all other articles which are rich in starch, are similarly digested.

Vegetables consist of much starch, some proteid, sugar, dextrin, and a little fat, and are very rich in salts which resemble those of the blood. Fruit contains various kinds of sugar, salts, organic acids, and pectin, or vegetable gelatine. Condiments contain various complex essential oils or other principles which render them useful as stimulants of the appetite, promoters of digestion and secretion, and act as correctives or prevent injurious action by certain foods. All vegetable substances consist of cells having their walls composed of cellulose, enclosing the nutritive saccharine and saline constituents. Now, cellulose is indigestible except under bacterial action in the lower bowel; but the digestive secretions remove the contents of the cells by osmosis, and many of the cells are burst asunder by cooking, thereby permitting the digestive juices to gain ready access to their contents, and the starch, proteid, fat, and sugar are digested and absorbed in the ordinary way; but most of the cellulose and vegetable fibres are rejected, and pass away with the fæces. Boiled vegetables and cooked fruit are usually easy of digestion; but heavy kinds, such as carrots, turnips, and fibrous cabbages, are most difficult to digest, and create pain and flatulence in many people. Raw fruit, vegetables and salad, which are very wholesome, and are especially beneficial to those who dwell in towns, are not so easy to digest as cooked ones. They are hardly changed at all in the stomach, except by removal of a portion of their juices, and must, therefore, be very carefully and thoroughly masticated to permit of their passage through the pylorus to the intestines. Radishes and cucumbers are mainly indigestible by reason of the large amount of cellulose by which the cells are enveloped; and turnips, carrots, and cabbage, because of the large proportion of indigestible fibrous material.

All *made dishes*, highly-spiced foods, curries, entrées, and other 'rich' food, are harmful, and often cause indigestion, liver trouble and hæmorrhoids, and are apt to check the secretion of the digestive fluids. We have already observed that pork is in-

digestible, because it contains a large quantity of easily-melted fat, which saturates every fibre; and all dishes which require much fat in the cooking are equally indigestible. Poultry is readily digested because it contains but little fat; duck and goose are indigestible because they contain much fat and oil of a peculiar character. Fish is always easily digested, unless much fat is used in cooking; nevertheless, some kinds contain a good deal of oil in their substance, which makes them heavy and require long digestion. New bread is indigestible, because it readily forms into close, firm pellets, which the digestive secretions penetrate with difficulty. Good bread of a day or two old is very digestible for the opposite reason—viz., it is spongy, readily crumbles, and the digestive secretions easily saturate it. Hot buttered toast, hot buns, crumpets, muffins, pastry, rich cake, and similar articles, are very indigestible, and should be classed with pork and 'rich' foods, because the butter or fat used in the cooking is melted into the flour, and, as this must be removed before the flour can be digested, the transformation of starch into sugar is very long delayed, and only occurs after the digestion of fat in the intestine; for which reason these articles of food are pernicious to a person with a weak stomach, in whom they cause headache, giddiness, flatulence, acidity, and other signs of indigestion.

References: Halliburton's 'Physiology'; Power's 'Physiology'; Hill's 'Notes on Physiology'; Foster's 'Physiology.'

CHAPTER IV

THE AFTER-HISTORY OF THE FOOD

How do the digested foods get out of the alimentary canal? The process is a physical and vital one. When two liquids of different densities are put together, they mingle with each other in a definite manner, until the whole liquid is of the same density, the process being called *diffusion*. In like manner, when two liquids of different density are separated from one another by an animal membrane, they mingle with each other by passing through the membrane, until that on each side is of the same density

as the other. This is called **osmosis**. The two processes are governed by the well-known law that the rate of diffusion is in proportion to the pressure and the density. There is, therefore, during the process of digestion a constant current from the blood in the coats of the alimentary canal towards the cavity of the stomach and bowels, bringing with it the digestive secretions and ferments from the glands; and a stream is constantly going from the interior of the alimentary canal, carrying with it the dissolved, digested, and diffusible substances of the food. The process is both intercellular and intracellular, and diffusion and osmosis are the processes concerned in it. But the vital activity of the cells lining the walls of the alimentary canal assists in absorption. All the cells take up nutrients from the canal and excrete them into the tissue spaces, from which they pass into the streams entering the blood and lymph vessels. The leucocytes in the walls of the canal, like amœbæ, are active agents in taking up nutrients from the fluids which bathe them, either for private or public use. They can be seen containing fat globules, particles of glycogen, and other products of digestion. But however the nutrients are absorbed, they get into the tissue spaces around the cells of the mucous membranes, and leave them by two distinct routes, the diffusible substances into the blood-stream, the indiffusible into the lymph-stream, and thence into the general circulation to every part of the body.

All **carbohydrate** enters the blood as sugar, where it assumes the form known as dextrose. The blood in general contains 1 in 1,000, but that in the liver, after a meal, contains as much as 2 or 3 per 1,000. We have already observed that the starch, which forms so large a proportion of bread, flour, potatoes, and many of our ordinary kinds of food, is changed by the digestive enzymes into **maltose**—a kind of sugar which is identical with that in malt. The change is not direct, only a small portion becoming maltose at once, the rest going through stages known as erythro-dextrin and achroo-dextrin; but the end product is always maltose, which is absorbed into the blood, or in the intestines is further transformed into dextrose prior to absorption. Three principal kinds of sugar are taken in our food. Cane-sugar, or saccharose, is the ordinary material used for sweetening our

food. In the stomach this is converted, by gastric juice acting upon it in the presence of mucin, into dextrose—

$$C_{12}H_{22}O_{11} + H_2O = 2C_6H_{12}O_6\,;$$

in the intestines it is converted into dextrose and levulose, but small quantities of dextrin and cane-sugar are absorbed without change. Fruit-sugar is mostly dextrose, and needs no transformation. Milk-sugar, or lactose, is changed in the stomach into galactose, and in the bowels into galactose and levulose, and absorbed.

The carbohydrate, being absorbed from the alimentary canal, is carried all over the body by the blood to supply the system with heat and muscular energy; and while supplying force and heat it undergoes more chemical changes, by which it is ultimately reduced to carbonic acid and water, in which forms it is removed from the body by the skin, lungs, and kidneys.

When more carbohydrate is consumed than is required for immediate consumption it leads to the formation of fat in the body, and the person becomes stout or obese; at the same time some of the unused carbohydrate is stored up in the muscles and liver, chiefly in the latter, in the form of glycogen. The cells of the liver are large protoplasmic bodies, capable of amœboid movement and in close contiguity with an immensely rich system of capillary bloodvessels, which are laden with material fresh from the alimentary canal. From these vessels the liver cells derive their nutriment, and in favourable conditions they can be seen laden with masses of glycogen, globules of fat, and stores of proteid material. The liver is therefore a reservoir of carbohydrate material or glycogen, and has been compared with the tubers of dahlias, potatoes, and other plants which store up starch for future use in their organism.

Glycogen has the same chemical formula as starch and dextrin, and bears the same relationship to the sugars. Its accumulation depends much upon the food: carbohydrates produce most, proteids some, gelatine a very little, and fat none at all. It is rapidly used up during active exercise and prolonged muscular exertion, and especially during fasting or illness, when the supply of food is much reduced. It is probably set free from the liver by means of an enzyme, which converts it into dextrose as it is

required; at any rate, most of the carbohydrate of the food finds its way to the liver, and the liver regulates the supply of dextrose to the blood. If this were not so, the system would be flooded with sugar after each meal; but, fortunately, the amount of sugar in the blood generally remains fairly constant, and does not appear to diminish so long as there is plenty of glycogen stored up in the liver and other tissues.

The **proteids** pursue a different career from the last-named foods. It is probable that all, or nearly all, the proteids used by the body are converted during digestion into peptones (anti- and hemi-peptone) by various stages, which can be watched by experiments in the laboratory. Being duly prepared by careful mastication, and subsequent maceration with gastric juice, some of the albumins and globulins are converted into peptone and parapeptone in the stomach; the peptone is absorbed into the blood, but the parapeptones pass with the chyme into the intestines, where they are converted by the trypsin of the pancreatic juice into antipeptone and absorbed.

Peptones having been formed by the transformation of proteid, they are absorbed through the walls of the alimentary canal, and gain entrance to the blood-stream. But peptone is not found normally in the blood which leaves these organs. What has become of it? Diffusion is a process by which fluids mingle with one another, but it cannot account for the disappearance of the peptones. An important change has taken place; the proteid leaves the stomach and bowels in the form of peptone, which is a substance not exactly adapted for the body, and arrives in the bloodvessels in the form of albumin, differing in no respect from those kinds which are found in the blood of other parts of the body. How is this done? The matter is not quite clearly understood at present, but it is extremely probable that the change takes place in the interior of the cells which line the alimentary canals, and which assist in the process of absorption. All cells contain enzymes, and it seems likely that the cells are the medium and the enzymes in them the actual cause of the transformation from peptone to albumin during absorption.

Proteids are used in the body for the current expenditure, being partly applied to the repair of tissues worn out by the wear and tear of the machinery, and in certain circumstances are

partly stored up in the form of fat in the body. The amount of proteid used can be measured. It is known that 1 part of urea contains as much nitrogen as 3 parts of proteid, whence the amount of proteid which is used in a given time can be estimated by the amount of urea or total nitrogen excreted in the urine during the same time. When the nitrogen thus excreted—and here roughly spoken of as the urea—corresponds in amount to the proteid contained in the food, there is established *a nitrogenous equilibrium*—that is to say, all the proteid is being used to repair the tissues only; the structures are neither dwindling away nor increasing in bulk; the elements are simply replaced as they wear out. If more proteid is eaten and digested than can be accounted for by the urea or nitrogenous excretion, the body must be laying on flesh; it is either stored up as granules of proteid in the liver, or it is converted into fat. Foster says that proteid is converted into a urea moiety and a fatty moiety—that when people live on an ordinary mixed diet any excessive consumption of proteid usually leads to fat, and continual excessive eating to obesity, from which it is evident that the body is capable of manufacturing fat for storage or for the production of heat and energy. It is not known whether the body can manufacture proteid from other materials: the substances used in its formation must necessarily contain nitrogen, which the starches and fat do not; but there are in beef-tea and other meat infusions and essences a large proportion of nitrogenous extractives derived from the metabolism of the tissues from which beef-tea or meat extract is prepared. Such are xanthin, hypoxanthin, creatin, creatinin, glycin, leucin, tyrosin, and other allied bodies. Is the body capable of constructing proteid from these? Probably not. These substances are the products of the *decomposition* of proteids; they are useless as tissue-formers, but they excite the metabolism of the body, and in so far are stimulants, and the beneficial effects of beef-tea and meat extracts are solely due to this influence.

The proteids in the body undergo decomposition by their use; they break up into such substances as the nitrogenous extractives named above, and go through lower and still lower grades of chemical composition, until they arrive at such a low grade as carbonic acid, water, and *urea*. So long as vital activity is in

progress, proteid is being used up and waste materials produced, which, like the waste products of the consumption of carbohydrate substances, leave the body by the skin, lungs, and kidneys, but chiefly by the latter. The principal normal waste product from the utilization of proteid materials by human beings is urea, but all nitrogenous materials go through several grades before reaching that stage; and the liver is the principal organ in which the final stage is reached prior to its excretion, the production of urea being an important function of that organ. There is constantly in the blood of man a small proportion (about $\frac{1}{2}$ per cent.) of urea, which allows for the daily elimination of 33 to 37 grammes by the kidneys; but this amount varies in proportion to the work done by the body, the amount of proteid substances consumed, and the state of health.

Fat is the most important representative of the hydrocarbons in our food. Common forms are fat meat, butter, cream, milk (part of), cheese (part of). Fat meat is a useful example for our consideration. During digestion the slight framework of connective tissue and protoplasm of the cells is peptonized, thereby liberating the fat or oil, which becomes emulsified and saponified in the intestines. The emulsion consists of minute particles of fat in a state of extremely fine subdivision, each of which has a tendency to assume a globular form; this, however, is more or less counteracted by the influence of the salts in the bile, which tend to destroy the surface tension, and assist them in their passage through the mucous surfaces. We have also observed that other portions of the fat are converted into forms of soap by the pancreatic fluid, a solution of which is readily absorbed. That a large proportion of the digested fat is absorbed by the lacteals and gains an entrance into the blood through the thoracic duct has been proved. After a meal the fluid in the lymphatic vessels, of which the thoracic duct is the largest, is quite milky from the presence of fat. But that all fat does not reach the blood in this manner has likewise been proved; for if the amount of fat which passes through the thoracic duct be compared with that absorbed (*i.e.*, with the amount in food *minus* that in the fæces), there is seen to be a deficiency of nearly 50 per cent., from which it is concluded that a good deal of it is absorbed directly into the bloodvessels in the form of the

soluble and absorbable soaps which are manufactured in the bowels.

However the fat gains entrance to the bloodvessels, it can be seen in the blood for some time after a meal in the form of fine globules. But the blood soon resumes its usual appearance. What has become of the fat? The leucocytes, or white cells of the blood, are seen to contain fat globules, and by them, or in some other way, the fat is carried all over the body to the tissues thereof; in the tissues it is used for the production of heat and energy and other current expenditure, being itself reduced to carbonic acid and water, which are excreted by the skin, lungs, and kidneys. It appears that all kinds of fat and oil are absorbed into the body in the same way, and are used for the same purposes. When there is a greater consumption of food than is necessary to supply current expenditure, fat is stored up in the subcutaneous and other cellular tissues. Animals with a suitable diet often put on more fat than their food contains; pigs accumulate much more fat in the body, and cows give more fat in their milk than exists in their food, whence it is concluded that the additional fat is derived from the conversion of some of the proteid and carbohydrate elements, which have already been shown to cause an accumulation of fat when there is a greater consumption of them than is necessary. People in cold climates eat much fat; but men who have to work generally prefer to derive their energy from carbohydrate and proteid material. To sum up the uses of fat in the body: It yields force and energy for work, and by consumption it supplies heat; it yields more heat than either of the other classes of food; it is also accumulated in the body as a reserve of force and energy; by its accumulation it serves to protect many important tissues and organs, and gives to the general surface that contour or curve which is the line of beauty.

REFERENCES: Hill's 'Notes on Physiology'; Foster's 'Physiology,' vol. ii.; Halliburton's 'Physiology'; Power's 'Physiology.'

CHAPTER V

THE VALUE OF FOOD TO THE BODY

Food is required to make good the losses of the body, to maintain its heat, to supply it with mechanical energy, to build up or repair the structure of the machinery, as well as for growth and reproduction; simply, the body is constructed out of the food, and by it kept in repair. Food, therefore, is either a flesh-former and repairer, or it is a source of heat and energy; materials such as coffee, tea, and extracts of meat, do neither, and cannot be regarded as true foods.

The quantity of food required by a man for the purposes named has been variously estimated. The most satisfactory method of calculating it is by ascertaining the amount of materials excreted from the body under various circumstances. It has been found that a man doing ordinary work excretes 5,000 grains (about 10 ounces) of carbon, and 500 grains (1 ounce) of nitrogen per diem. Women excrete less of these substances than men, but children excrete more in proportion to their weight than adults, because of their great activity and progressive development; in old age, however, the amount, especially of nitrogen, falls considerably. The average excretion of nitrogen is reckoned as being 0·5 gramme per kilogramme, or 7 grains for every 2 pounds of body weight. The excreted nitrogen is estimated in the form of urea, and carbon as carbonic acid gas.

The amount of urea excreted daily varies with circumstances; the average normal amount is 33 grammes, or 509 grains, but when the diet consists wholly of proteid material it is 35, 50, or even 80 grammes per day. The amount is less, however, if the food consists entirely of carbohydrate and vegetable, and it may then sink to 12 or 18 grammes; and when no food at all is taken urea is excreted to the extent of 10 grammes, or 150 grains, per day, which must be derived entirely from the wear and tear of the bodily tissues by vital activity. Work or rest appears to have very little effect on the amount of urea excreted. During a period of rest very little less is excreted, and during or soon after hard work there is only a slight rise above the normal amount, which

is due to the disintegration of the tissues, and shows that the daily depreciation by wear and tear of the machinery is not great when food is taken; it also shows that the real source of the energy used is derived from the carbohydrates and hydrocarbons of the food, for the amount of nitrogenous waste matter which is excreted is not at all adequate to account for the work performed.

A healthy man doing ordinary work requires more food, both proteid and carbohydrate, than the same man at rest; when men do little work, or the occupation is more or less sedentary, they require less proteid than those whose work is active or laborious. It must be borne in mind, however, that even in cases of starvation with absolute rest of the body there is a wasting of the bodily tissues equivalent to a loss of 10 grammes, or 150 grains, of urea daily, whence it may be inferred that it is neither wise nor safe to reduce the supply of proteid below the amount which will replace the tissues wasted to produce this *minimum* of urea; indeed, Moleschott, a careful investigator, asserts that we cannot safely reduce the amount of proteid below what is required to supply 20 grammes, or 300 grains, of urea, which is excreted by a man during absolute rest.

When arranging dietaries, it is usual to allow three-fourths the amount of proteid for a woman as for a man, for children of eleven to fifteen years of age the same amount as for a woman, for those under ten half as much, while for young men in active employment the same amount as for adults in the same employment.

The carbon used in the body is derived from the carbohydrates and hydrocarbons of our food, or those stored up in the tissues. The nutritive value of fat, as compared with starch or other carbohydrate, is as 10 to 17, but the heat-producing power of fat is to that of starch and similar foods as 9·3 is to 4·1; and in calculating the amount of food for bodies of men it is usual to allow as much of these substances as will supply the carbon excreted in a day as carbonic acid gas, estimated as being 300 to 324 grammes, or 4,500 to 5,000 grains.

Dietaries are usually arranged in agreement with the average excretion of nitrogen and carbon; and the amount of these substances excreted during a period of absolute rest, 300 grains of urea and 4,500 grains of carbon, is the minimum below which it

is regarded as unsafe to reduce the foods to supply them, and the proportion of carbon to nitrogen required is therefore as 15 to 1. Many investigators have made calculations, by experiments upon themselves and other men, of the amount of food required to supply these items; at the same time, their object has been to establish a nitrogenous equilibrium, to keep their weight constant, to establish a balance between the nitrogen in their food and that found in their excreta. The results are highly interesting, but they show a variation in the dietaries of the investigators, probably owing to personal peculiarity or idiosyncrasy and other circumstances; they also show *that no hard-and-fast rule can be established for all men*, although the tables are exceedingly useful in calculating dietaries for public institutions or large bodies of men. Moleschott found that a diet which contained 120 grammes of proteid, 90 of fat, 330 of carbohydrate, and 30 of salts per diem, best attained these objects for himself. But Ranke, another ardent investigator, found his weight and health were best maintained on a diet containing 100 grammes of proteid, 100 of fat, 240 of carbohydrate, 25 of salts, and 2,600 of water per diem; he chose his food from ordinary articles which he liked, without regard to character or cost, but he also found that the required elements could be obtained from a simple diet consisting of 17 ounces of meat, 4 ounces of butter or other fat, and 17 ounces of bread. Parkes found that a man doing ordinary work may obtain the necessary carbon and nitrogen, and maintain his weight and health, from 8 ounces of meat, 2 ounces of butter, and 28½ ounces of bread. The latter authority also gives the following interesting table of diet, showing the amount of *dry food* required for (1) mere subsistence—that is, just enough food to do the internal mechanical work of the body when a man is at rest; (2) for a man doing ordinary work, in which there is a consumption of visible energy equal to 300 foot-tons per diem; and (3) for a man doing laborious work, in which there is a consumption of energy equivalent to 450 to 500 foot-tons per diem; and they are calculated for a man of average size and weight (150 pounds).

TABLE FROM PARKES' 'PRACTICAL HYGIENE.'

	Weight, stated in Ounces.		
	Subsistence.	Ordinary Work.	Laborious Work.
Proteids or albuminates ...	2·0	4·5	6·5
Hydrocarbons or fats	0·5	3·5	4·0
Carbohydrates	12·0	14·0	17·0
Salts	0·5	1·0	1·3
Total water-free food ...	15·0	23·0	28·8

The above quantities represent absolutely dry food; therefore, as ordinary food contains 50 to 60 per cent. of water, they should be rather more than doubled when making calculations for any particular dietary. The following list of foods, also quoted from Parkes' 'Practical Hygiene,' shows the proportion of proteid or albuminate, the fat, carbohydrate, salts, and water in each; and Parkes states that 1 ounce of albuminate contains 70 grains of nitrogen and 212 grains of carbon, 1 ounce of fat contains 336 grains of carbon, and 1 ounce of carbohydrate 190 grains of carbon.

	Percentage Composition.				
	Proteid.	Carbo-hydrates.	Fat.	Salts.	Water.
Cooked meat (no loss)...	27·5	—	15·5	3·0	54·0
White fish	18·0	—	3·0	1·0	78·0
Egg	13·5	—	11·6	1·0	73·5
Milk (sp. gr. = 1030) ...	4·0	4·8	3·7	0·7	86·8
Cheese	33·5	—	24·3	5·4	36·8
Butter	3·3	—	88·0	2·7	6·0
Bread (white or brown)	8·0	49·0	1·5	1·5	40·0
Wheat flour	11·0	70·3	2·0	1·7	15·0
Barley-meal	12·7	71·0	2·0	3·0	11·3
Oatmeal	12·6	63·0	5·6	3·0	15·0
Rye meal	13·1	69·3	2·0	2·1	13·5
Peas (dried)	22·0	53·3	2·0	2·4	15·0
Rice	5·0	83·0	0·8	0·5	10·0
Maize	10·0	64·5	6·7	1·4	13·5
Arrowroot	0·8	83·3	—	0·27	15·4
Sugar	—	96·5	—	0·5	3·0
Potatoes	2·0	21·0	0·16	1·0	74·0
Cabbage	1·8	5·8	0·5	0·7	91·0

Moleschott, when arranging a dietary for young active adult soldiers, allowed 130 grammes of proteid, 84 of fat, 404 of carbohydrate per diem, which is a generous allowance; and he calculated that the required quantity of proteid or carbohydrate could be obtained from the amount stated against the article in the adjoining list. The English equivalent is given beside the French weight.

MOLESCHOTT'S TABLE (ARRANGED).

	130 Grammes of Proteid may be obtained from—			404 Grammes of Carbohydrate may be obtained from—		
	Grammes.		Ounces.	Grammes.		Ounces.
Cheese	388	equal to	$12\frac{1}{2}$	2,011	equal to	71
Lentils	491	,,	$17\frac{1}{4}$	806	,,	$28\frac{1}{2}$
Peas	533	,,	$20\frac{1}{2}$	819	,,	29
Beef	614	,,	$21\frac{1}{4}$	2,261	,,	80
Eggs	969	,,	34	902	,,	$31\frac{3}{4}$
Wheaten bread ...	1,444	,,	51	625	,,	24
Rice	2,562	,,	$90\frac{1}{2}$	572	,,	20
Rye bread	2,876	,,	$100\frac{1}{4}$			
Potato	10,000	,,	352	2,039	,,	73

The above estimates confirm the classification of foods by showing that for yielding proteid the advantage is decidedly in favour of meat, peas, beans, lentils, cheese, and other nitrogenous foods; but for carbohydrate the advantage is with bread, rice, sago, and other starchy foods. The table is of economic value in showing that a combination of bread and meat, bread and cheese, or rice with a highly nitrogenous food is the most economical diet as regards the physiological work to be performed in its digestion and elaboration. As a rule, four times as much non-nitrogenous as nitrogenous food is required to supply the due proportion of carbon and nitrogen.

The advantages of a mixed diet are that it is the most economical, and spares the organs which are exercised in digesting the food and removing the débris. Supposing bread alone to be eaten, it will be necessary to consume $4\frac{1}{2}$ pounds of this material to obtain the 300 grains of nitrogen which is considered to be the least quantity which may safely be allowed; but this amount will contain 9,000 grains of carbon, or double the amount required, and would throw extra work on the digestive and

eliminatory organs. If lean meat be taken alone, $6\frac{1}{2}$ pounds must be consumed in order to obtain the 4,500 grains of carbon necessary to supply the daily amount of heat and energy; but this quantity would contain 1,350 grains of nitrogen, and the consumption of so much meat (equivalent to $\frac{1}{25}$ of the average weight of a man) would involve a tremendous waste of nitrogen. Even if his digestive organs were equal to such a daily task, he would consume, and his organs would have to eliminate, three or four times as much nitrogen as his body could fix. Life cannot, therefore, be economically maintained upon either of these substances alone, and similar arguments apply to many other foods. But bread and meat in combination form a good example of a simple mixed diet, which will supply the requirements of the body with very little excess of either element when the consumption is regulated by the facts thus elicited. According as more or less bread, more or less meat, is eaten, either of the following—Parkes' diet for a man doing ordinary work, viz., 8 ounces of meat, 2 ounces of butter, $28\frac{1}{2}$ ounces of bread; or Ranke's dietary, 17 ounces of lean meat, 4 ounces of butter or fat meat, and 17 ounces of bread—will contain the amount of carbon and nitrogen required, and show the advantage of a mixed diet containing the simplest combination of proximate principles.

THE WORK DONE BY THE FOOD.

A day's food yields, according to Ranke's estimate, his own requirements being taken as a standard, 2,310,000 calories or units of heat by its oxidation into urea, carbonic acid, and water. The calorie, gramme-degree, or unit of heat, is the amount of heat required to raise the temperature of 1 gramme of water 1° C. Our food contributes the following proportions to it: 1 gramme of fat gives out during its oxidation or complete combustion 9,300 calories; 1 gramme of proteid, 4,500 calories; and 1 gramme of carbohydrate, 4,100 calories.* All organic substances when consumed serve as sources of heat and energy by becoming oxidized in the

* The calorie is the term used to signify the standard of heat-production by all authorities, but it has been given a different value by some, who reckon it as of 1,000 times greater value. According to these, the unit of heat or calorie is the amount of heat required to raise the temperature of 1 kilogramme of water 1° C, and 1 gramme of fat yields 9·3 calories, 1 gramme of proteid 4·5, and of carbohydrate 4·1 calories; consequently, the work done by Ranke's allowance of food is equivalent to the production of 2,310 calories or units of heat.

tissues. The proteids and carbohydrates are of nearly equal value as heat-producers, and only half as valuable as fat for this purpose ; on the other hand, though only half as potent as fat as producers of heat, the carbohydrates are admitted to rank first as producers of muscular energy. The 2,310,000 calories or units of heat would, if transformed into physical energy, suffice to raise 1,000,000 kilogrammes of water to a height of 1 metre (=1,000,000 kilogramme-metres). This energy is dispersed by the body in the following manner : 150,000 kilogramme-metres, or only 15 per cent. of the whole energy from the food, is used in doing the ordinary day's work, and 85 per cent., or 850,000 kilogramme-metres, of energy are consumed by the body in keeping up the warmth and performing the internal work of the organism.

Parkes and other English authorities used the mechanical term 'foot-ton' instead of the calorie as their unit of measurement. A *foot-ton* is the amount of energy required to raise a mass weighing 1 ton to a height of 1 foot above the ground, and the use of this unit gives similar results. During a **state of rest** a man gives off as much carbonic acid gas as would require the consumption of 2,400 foot-tons of energy in its production, and during an *ordinary day's work* 3,700 foot-tons. One ounce of dry albuminate will yield 173 foot-tons ; 1 ounce of dry carbohydrate, 135 foot-tons ; and 1 ounce of fat, 378 foot-tons of potential energy. From which it is calculated that Parkes' 'mere subsistence' diet (2 ounces dry albuminate, ½ ounce fat, 12 ounces carbohydrate, and ½ ounce salts) will yield 2,155 foot-tons of energy ; Playfair's 'subsistence' diet (2½ ounces dry albuminate, 1 ounce fat, and 12 ounces dry carbohydrate) is capable of yielding 2,430 foot-tons of potential energy ; and the *average diet* yields about 4,000 foot-tons, of which 300 are exhausted in doing an ordinary day's work, and 3,700 are required to maintain the bodily heat and perform the functions of the body in maintaining it in a state of efficiency to produce that degree of physical activity.*

The amount of energy yielded by our food may theoretically be accurately gauged, and is undoubtedly produced when the constituents are completely oxidized into carbonic acid and water. But we know that many kinds of food leave a large

* 'Hygiene and Public Health,' by L. C. Parkes, pp. 337, 338.

residue, and their dietetic value depends upon their digestibility and the capability of the individual to assimilate it. No hard-and-fast rules can be given which are adapted to all individuals; they are useful in calculating the amount of food required by large bodies of men and for public institutions, but a glance over the dietaries quoted in the following chapters will show that some of them, if they err at all, do so on the side of generosity.

THE COST OF FOOD.

Food is cheapest when its proximate principles are derived from the vegetable kingdom. According to König's calculation, the **animal** kingdom yields them at the following cost: 100 grammes of proteid cost 65 pence, 100 grammes of fat 20 pence; from the **vegetable** kingdom 100 grammes of proteid cost 15 pence, 100 grammes of fat 4·5 pence, and 100 grammes of carbohydrate 2·5 pence.

During an investigation of the dietaries of the working classes by Noël Paton and Crauford Dunlop similar results were arrived at, and in a report upon the subject they gave the following conclusions:

'It is impossible to find a standard diet from which the supply of energy may be exactly drawn. The energy required varies with the age of the person and the work to be done. . . . Food is the sole source of energy for work; and the working capacity of a man is conditioned by the amount of food he consumes. . . . Insufficient food diminishes the working power by preventing the full development of muscle, and by not affording energy for the work to be done.

'Bread forms the basis of all diets. It provides an average of one-third of the total energy and one-third of the total proteid used. It is a cheap food. For providing energy we find only oatmeal and sugar are cheaper; for providing proteid we find only oatmeal and peas are cheaper.

'Potato is a more expensive food than bread; both as energy and proteid provider it is twice as dear, but its antiscorbutic properties justify its use in dietaries.

'Milk is comparatively expensive. As a source of energy it is five times, and as a source of proteid it is three times, as dear as bread; but it is essential in the diet of small children.

'Sugar is one of the most important foodstuffs of the poor. It is solely an energy-provider, but for this purpose it is cheapest of all.

'Beef is an expensive source of nourishment. Its proteid is four times as dear, and its energy nine times as dear, as that of bread. Ham is cheaper than beef, both as energy and proteid provider, and so are sausages and mutton.

'Fresh fish is cheap as proteid-provider, but dear as energy-provider; smoked and dried fish is expensive both as energy and proteid provider.

'Eggs are expensive both as energy and proteid provider. Their large use may be attributed to the small amount of trouble required in cooking them.

'Butter, margarine, dripping, and suet are cheap foods as a source of energy, only sugar being cheaper. They rank third as a source of energy.

'Cheese is a cheap source of both proteid and energy.

'Oatmeal costs less than bread as a source of both proteid and energy. Peas are cheaper than oatmeal as proteid-provider; and sugar is cheaper as energy-provider, but the latter contains *no* proteid. As a food providing cheap energy, and having a good proteid value, oatmeal is the best of the entire list.

'Without an adequate supply of food, growth and development of the body are impossible, the working capacity of the individual is reduced, and a predisposition to disease is induced. . . . A dietary consisting only of tea with bread-and-butter is faulty; it can be improved by the free use of meat and other animal foods, but these are expensive; it can also be improved by the free use of oatmeal and milk, or peas, beans, or lentils, which add little to the cost, but require much more care in the cooking. A daily diet containing meat need not cost more than sevenpence, but when meat is replaced by peas and beans or oatmeal and milk it need not cost more than fourpence per diem.'

The great point is that people require to be educated in the comparative value of foods as well as in the art of cooking. The pulses are exceedingly valuable, for instance, as proteid-providers, but great care is required in cooking them. Dr. Noël Paton says: 'The large use of food which provides energy but not proteid is one reason why the dietaries of the poor are so badly balanced; they contain but little proteid comparatively to their energy.'

The pulses, peas, beans, lentils, contain quite as much proteid as meat, and should be used more abundantly than they now are in all families where the cost of meat is a matter of great consideration. A glance at the composition of food in the foregoing lists and the following chapters will show which foods are the best suited for providing proteid or flesh-forming food, and for energy, which is provided by the carbohydrates and fats.

COOKING THE FOOD.

The object of cooking our food is to make it more wholesome, palatable, and easier of digestion. Prolonged exposure to heat develops in meat certain aromatic bodies which are agreeable to smell and taste and encourage appetite, besides rendering the substance more congenial to the civilized palate. All flesh is sterilized by cooking, thus destroying bacterial and other noxious organisms, and preserving it from putrefactive changes. The effect of heat is to coagulate albumin in the muscular fibres, to solidify fibrin, to gelatinize tendons and fibrous tissues, and to render the whole mass more agreeable to the palate, pleasing to the eye, wholesome and digestible.

Most kinds of food lose more or less bulk in cooking. Beef loses a quarter and mutton a fifth on boiling, and more on roasting. In roasting the loss arises by the melting out of fat and evaporation of water, while some of the albumin and other substances from the surface escape into the gravy and enrich it. In boiling gelatine also is extracted. Roasted or baked meat is usually more nutritious than boiled.

Baking Meat.—The object is best attained by exposing the meat to a high temperature in a quick oven for about five minutes, by which means the albumin on the surface is coagulated and forms a coating which prevents the escape of the juices from within. The meat is then more slowly cooked at about 175° to 200° F., so that it may attain a proper degree of heat internally. If it is kept at too great a heat, it will be dry or burnt on the outside and nearly raw inside; while if it is put in an oven which is too slow at the beginning, the meat will be spoiled by the escape of too much juice from the interior. Liebig stated that beef or mutton is not cooked until it has attained a temperature of 158° F. throughout the whole mass; but poultry and game,

although requiring a hotter oven than butcher's meat, are more quickly cooked, and need only attain a uniform temperature of about 130° to 140° F. The peculiarity of **baking** depends upon the substance being heated in a confined space or oven which does not allow the steam and fumes arising from the meat to escape ; and the flesh is rendered more tender and sapid by the retention of its own juices. Baked meat is not quite so easily digested as roasted, on account of the greater retention of the oils, which are rendered empyreumatic and indigestible by great heat ; it therefore requires the addition of various condiments to aid the stomach in the performance of its work.

Meat is **roasted** in front of a fire. A radiant fire filling the grate is necessary for a large joint, while a thin and smaller one requires a smaller but bright fire. Great care is necessary in the management of the temperature, and a joint should never be put down before a fire which is nearly exhausted or will speedily require replenishing. Likewise, if the fire becomes too fierce, the joint should be removed some distance from it until the fierceness is somewhat abated. The temperature it attains internally is that of baked meat.

When meat is **broiled**, it is placed upon a bare fire consisting of clear red-hot cinders ; by this means the exterior is suddenly browned and hardened, evaporation is thereby prevented, and the meat is cooked in its own juices, which impart to it a peculiar tenderness and flavour. **Grilled** meat is done in the same way, the grill being a handy instrument for placing it over the fire and removing it. This is the form of cooked meat considered to be most suitable for those who seek to invigorate themselves by training and athletics.

Frying is the most objectionable method of cooking meat or fish from a medical point of view, because the heat is applied through the medium of boiling fat or oil, which becomes empyreumatic, and makes the meat more indigestible and most liable to disagree with the stomach.

When **boiling**, like roasting or baking, the meat, if intended to be eaten, should be exposed to the influence of a boiling temperature for five or more minutes until the albumin in the outer layers is coagulated, which will prevent the escape of the internal juices ; it is then cooked by simmering it at 170° to 200° F. Fish

requires boiling more gently than meat, or it will fall to pieces. A little salt is usually added when boiling meat or fish. A scum rises to the surface, aided by the salt, and should be removed at intervals, otherwise it will dissolve in the liquid and spoil the appearance of the meat.

By cooking vegetables the cellulose envelopes are burst asunder in consequence of the heat, so that when they are eaten the digestive ferments of the alimentary canal can more easily get to the starchy or albuminous contents. In bread and other glutinous foods the albumin is coagulated, and in bread it sets in a permanent vesicular mass which the digestive secretions can readily permeate. In green vegetables the fibres are softened, the albumin coagulated, the gummy, saccharine, saline, and oily matters partly removed by the water. Green vegetables should be boiled fast with the lid off the saucepan, and frequently skimmed. Rain-water is especially useful for cooking, on account of its softness, freedom from salts of lime and magnesia. These salts are present in hard water, and when vegetables or meat are boiled in it a certain amount of salts are deposited, thereby increasing the scum and, when they are deposited upon the meat or vegetables, hindering the penetration of heat into the interior, or preventing the abstraction of soluble materials when making broth or soup.

It was formerly thought that well-cooked food never wrought any harm, but the unfortunate experience of thousands has changed that opinion. 'High' game, for instance, is in the first stage of putrefaction, or, as Pasteur stated, in a preputrefactive stage. This condition is produced by certain micro-organisms or bacteria which are constantly floating in the air, and find a convenient place for living and breeding in the juices of the flesh. It is difficult to say how long it is necessary for game to hang in order to obtain the proper game flavour, and the boundary-line between this stage and putrefaction is very narrow and easily passed without recognition. The game flavour is due to the metabolic activity of the micro-organisms which have settled in it, which, by a process allied to that of fermentation, produce changes in the albumin and other constituents, and give rise to certain aromatic bodies. Such micro-organisms contain an enzyme which may so act upon the albuminous portions of the flesh as to produce substances known as ptomaines and leuco-

maines, which are of a decidedly poisonous character. An explanation is thus afforded of the action of apparently well-cooked food in producing ptomaine-poisoning. The heat employed in cooking a substance destroys the bacteria in it, and the food may be safely eaten while it is hot; but the heat may not have been great enough to destroy the enzyme of such bacteria, and this goes on destroying albumin and producing ptomaines or leucomaines even after cooking; whence it happens that a dish of tainted meat is sometimes eaten quite safely immediately it is cooked, but a few hours afterwards, ptomaines having been produced by the enzymes, it has become very poisonous. Many articles of food have given rise to such an experience; and ptomaine-poisoning has arisen from the consumption of tainted meat in any form, especially meat-pies, sausages, potted meat, fish, mussels and other shell-fish, tinned foods, and puddings made of mouldy bread.

References: Power's 'Physiology'; Foster's 'Physiology,' vol. i.; Halliburton's 'Physiology'; Parkes' 'Hygiene and Public Health,' 3rd ed.; 'A Report on an Investigation of the Food of the Working Classes,' by Noël Paton and Crauford Dunlop, *Brit. Med. Jour.*, 1904.

CHAPTER VI

VEGETARIANISM

We have seen, by our consideration of the cost of feeding, that the question of cost alone is decidedly in favour of a vegetarian diet, for both flesh-forming or proteid and energy producing material can be obtained at much less cost from the vegetable than the animal kingdom. Persons of limited income are therefore rightly advised to adopt a freer use of the proteid material provided in peas, beans, and lentils in the form of soup, purée, haricot beans, or other 'dish' of the vegetarian order. They may thus materially improve a dietary in which the proportion of meat is deficient. We also saw that if a man lives upon meat alone, he must consume $6\frac{1}{2}$ pounds daily to obtain as much carbon as is required for the production of the energy for an ordinary day's work; but by consuming that quantity he would take in so much more proteid than he required that an excessive amount of work would be thrown upon his organs to deal with it. And likewise, if a man live upon bread alone, in order to obtain the necessary

proteid for his day's use, he must consume double the amount of energy-producing material. Similar remarks apply to many foods, from which it is concluded that physiological economy is best served by the diet consisting of a due proportion of animal and vegetable materials. The physiological value of a vegetarian diet will be referred to again in a later chapter.

FOOD DISEASES.

Something has to be said on the score of health. A purely vegetable diet is usually productive of less evil to persons of more or less sedentary occupation than one consisting largely of rich animal food. Those who advocate the *exclusive* use of animal food adduce in support of their system the herculean strength and rude health of our hardy ancestors. The British aborigines, it is urged, were not acquainted with the cultivation of the ground; but, according to Cæsar, Strabo, Diodorus Siculus, and other writers, they lived upon flesh and milk almost entirely. In answer to this we must draw attention to the different habits and modes of existence in the present day. Animal food is undoubtedly more stimulating than vegetable food, even the pulses; but an exclusively animal diet could not safely be indulged in by the majority in our day or in our climate, still less in tropical or Oriental countries: it is too highly stimulating, life is urged on too rapidly, and many diseases are a consequence of excessive consumption of animal food. Too much meat produces an excess of nitrogenous waste matters in the system, which entails much work upon the liver, kidneys, and other organs to eliminate it; if it is not excreted, or if the proper changes in the waste materials do not take place, they accumulate in the system, in the blood and tissues, and gout, gravel, stone, kidney and liver diseases, or other diseases attributable to uric acid, are the result.

The germs of disease may be communicated to man by the flesh of animals infected with anthrax, foot and mouth disease, rabies, glanders, tuberculosis. Gastric irritation sometimes follows eating very high game, in which an acrid fatty substance may be formed; at other times ptomaine-poisoning follows the consumption of animal food which is tainted, or too 'high,' or even partially decomposed. Various parasites in meat are transmissible to man, as the round and tape worm, and *Trichina spiralis*,

which find a home within their host, as the result of eating raw or underdone meat containing the ova or partially-developed tæniæ. Shell-fish, oysters, mussels, whelks, cockles, are known to be an active means of disseminating enteric fever. Milk is also the means of transmitting various diseases to the consumer, as enteric or scarlet fever, diphtheria and tuberculosis, besides other diseases due to the presence of fungi. But all these germs, even the tæniæ, may be destroyed by heat, although it is extremely undesirable that milk, meat, fish or shell-fish known to be unsound or suspected to be contaminated by these diseases should be consumed; it is nevertheless true that they are more often transmitted to human beings by other means, but might be much more commonly spread in this way were it not for the care taken to prevent the sale of unsound food, polluted milk, diseased meat, etc., and for the additional safeguard we have in cooking them.

Vegetarian authors, who usually write with bias, do not take these precautions into sufficient consideration, nor do they range alongside of these facts others which show, unfortunately, that quite as evil diseases may and do arise from the vegetable articles of our food. An excess of bread, for instance, or other starchy or carbohydrate food from the vegetable kingdom, produces flatulence, acidity of the stomach, indigestion, congestion of the liver, hæmorrhoids, and promotes obesity with its attendant evils. Sugar, too, has an enormous dietetic value as a producer of force, but an excess of it will produce similar evil results, especially catarrh of the stomach, in which the excess of mucus envelopes particles of other food and hinders the proper action of the gastric juice, whence indigestion of food and other symptoms of gastric catarrh ensue.

Eating raw vegetables is undoubtedly a cause of enteric fever, especially the consumption of salads, lettuce, watercress, radishes, onions, celery, etc.; indeed, whenever vegetables during their growth are irrigated with sewage containing valuable nitrogenous plant foods, care must be taken that such plants are not eaten raw, for by such means the germs of typhoid and other diseases may be scattered broadcast. Merely washing them is not sufficient to cleanse them from such germs, and vegetables from such a source should not knowingly be eaten raw, however nice they appear to the eye. Farms on which sewage is largely used as a

means of sewage disposal are usually under municipal control, and only such market produce as must necessarily be boiled before eating them, as cabbage, beet, potatoes, turnips, swedes or mangolds, ought to be grown thereon.

The consumption of unripe or over-ripe fruit is frequently blamed for attacks of diarrhœa or choleraic diarrhœa; foreign fruit may also be a source of fevers and other diseases not common to temperate climates. The ingestion of hard, indigestible fruit, vegetables, and nuts, is the cause of much suffering in the form of catarrh of the stomach or intestines, diarrhœa, constipation, or other ailments.

That terrible disease, hydatids, is due to a minute tapeworm, the *Tænia echinococcus*, which gains entrance to the human organism as the ova or partially-developed tænia upon uncooked vegetables—such as watercress, celery, lettuce, and other salads. From the ova are developed such numerous cysts as may give rise to a tumour or tumours of many pounds weight, necessitating an operation of some magnitude for their removal. The parasite, once it finds entrance to the body, soon gets accustomed to its host, and from one or two ova mother and daughter cysts may grow in thousands and spread to every part of the body. If vegetables which are to be eaten raw are laid in a mixture of salt and water for an hour or two previous to their consumption, the salt will kill such ova, as well as some other slimy things which may be attached to them. It is unfortunate that so simple a remedy will not destroy the bacteria of enteric fever.

Actinomycosis, another dreadful disease which is obtained through the vegetable kingdom, is caused by the ray-fungus which grows upon cereals and some other vegetables. It is commonly contracted through eating growing corn, as by plucking an ear of wheat and rubbing out the grain and masticating it. The fungus may affect the whole alimentary canal, beginning at the mouth, whence it spreads to other organs. The chance of recovery is very remote when the fungus gets fairly established.

Ergotism is likewise due to a fungus, *Oïdium abortifaciens*, or *Claviceps purpurea*, which grows upon rye; the disease is very common among the consumers of rye bread, or 'black bread.' The symptoms of ergotism are mainly painful cramp and coldness of the extremities, followed by dry gangrene in extreme cases.

Pellagra is a wasting disease, accompanied by an erythematous eruption on the skin, which affects chiefly persons who live largely upon maize, as the inhabitants of Lombardy. The disease is due to degeneration in the meal, and two kinds of *mould* have been recognised as being always present in it.

Beri-beri, a disease of the nervous system distinguished by wasting of the muscles and gradually increasing paralysis, is prevalent in foreign nations where rice is largely eaten. The association of rice with the origin of beri-beri has been as keenly disputed as that of fish with the origin of leprosy.

Cholera and choleraic diarrhœa and dysentery are almost certainly conveyed into the system by food which is polluted, or by the evacuations of such sick persons contaminating the air or water which others consume. Flies and similar insects are the unceasing agents of disease: they constantly alight upon whatever takes their fancy, be it the food of man, or garbage, or the evacuations of a case of typhoid, cholera, or dysentery; that flies are scavengers may be true, but unfortunately it is too true that they play a great part in disseminating disease.

In summing up this matter, we must state that the albuminates, proteids, nitrogenous or flesh-forming elements in meat, milk, eggs, and fish, and in bread, peas, beans, lentils, and other vegetables, are of nearly equal nutritive value, only some of them are more easily digested than others. A meal of meat and its accompaniments requires from four to four and a half hours for its complete digestion, while a meal of white fish, milk, or eggs, is digested in half the time; but the vegetable proteids require a longer time for their digestion. Now, if more animal proteid is eaten than is required for immediate consumption, some of it is stored up in the body either as proteid or fat; but it is urged against vegetable foods that their proteids are only used for current expenditure, and are not stored for future consumption. Animal fat is also more easily digested than the oil in vegetables. A diet containing animal food is more stimulating than a purely vegetarian diet, although most of our energy producing food (except fat) is derived from the vegetable kingdom.

Concerning the necessity for vegetable food, it is well known that scurvy was an exceedingly common ailment in England up to the seventeenth century, and a heavy mortality was due to

that cause ; also that gardening was then scarcely known, that most of the vegetables, such as cabbage, lettuce, celery, and others, were uncultivated. Since then, however, gardening has become common, vegetables form almost a constant portion of our diet, and in consequence the ravages of scurvy have become nearly unknown. Fresh vegetables, potatoes, and fruit, contain many salts which are necessary for the proper constitution of the blood and other fluids of the body ; if they are withheld from the food for a long period the blood becomes impoverished and scurvy results. While vegetables are necessary, an exclusive vegetarian diet is inconsistent with our knowledge of man's ability to live upon all kinds of food, that vegetable foods alone entail a larger amount of work on the digestive organs, and are not sufficiently stimulating for the active exertions which belong to our present civilized condition. A vegetarian diet suits some people better than a diet containing meat, and *vice versâ ;* some people feel lighter and more active immediately after a vegetarian meal who complain of heaviness, drowsiness, and want of energy after a hot dinner of meat with the usual accompaniments. It is a fact that the wealthy classes eat too largely and too frequently of meat, and they suffer in consequence from diseases which are little known among strict vegetarians. But there is not sufficient evidence to show that a vegetarian diet is productive of a greater duration of life than a mixed diet.

We are rather compelled to the conclusion that the normal diet of man is a mixed diet of meat and vegetables and fruit ; that with carefully-cooked food there is little danger of infection or the transmission of parasites ; that excess of any kind of food is equally bad ; that to eat a heavy meal when one is fatigued by labour is bad ; that a short rest after a meal is best ; and that safety consists in eating moderately of easily-digested and well-cooked food of a mixed character, having a due proportion of the flesh-forming and energy-producing elements.

PTOMAINE-POISONING.

Ptomaines and leucomaines are substances of a proteid nature which resemble the powerful vegetable alkaloids in their composition and poisonous effects. Some ptomaines are found in animal matter which is undergoing decomposition, such as **tyro-**

toxicon in old cheese and **mytilo-toxicon** in shell-fish under certain conditions. They have also been found in pork, sausages, potted meat, ice-cream, mouldy bread, oysters, mussels, crabs, lobsters, mackerel, eels, and conger-eels. If the jelly belonging to any portion of food such as a pork-pie, a tin of meat or tongue, calves'-foot jelly, or bottle of soup, has become liquid, this is a sign that bacterial action has taken place in it, that ptomaines or tox-albumins have been developed, and that their use for food would be dangerous. The epidemics of food-poisoning occasionally reported have all had their origin in the production of ptomaines in the food before it was consumed. Ermenglin* says that the toxic ptomaines found sometimes in preserved meat, ham, game-pies, etc., are due to a specific micro-organism, *Bacillus bolulinus*, which secretes a soluble ptomaine called by him **boluline**; it is intensely poisonous, but is destroyed at a temperature of 60° to 70° C., and the bacillus which produces it at 85° C., so that thorough cooking should prevent all danger from this source, provided there is no fresh infection after it is cooked.

The symptoms of ptomaine-poisoning may develop in ten or fifteen minutes, or be delayed as many hours after the meal. Sometimes they are simple cases of **urticaria** or nettle-rash; that is, an eruption on the skin of firm, round, or oval swellings, size from $\frac{1}{4}$ inch in diameter upwards, sometimes large **pomphi** or wheals, having a whitish centre upon a pink or reddish elevation, and attended with intolerable itching. There may be a feeling of suffocation or difficulty in breathing; at other times extreme muscular weakness, numbness of the limbs, a feeble action of the heart, epileptiform convulsions, strychnia-like twitchings, or coma; sometimes, instead, there may be sickness, purging, cramp of the extremities, and other choleraic symptoms.

The most poisonous ptomaines are produced during the course of various diseases by the bacteria. These are called **toxins**—*e.g.*, typho-toxin in enteric fever, tetanine in tetanus. Leucomaines, albumoses, or tox-albumins, are also mainly the result of bacterial activity, and are undoubtedly poisonous. But some bodies belonging to the leucomaines are produced without bacterial action during animal metabolism. Such are the albumoses or proteoses and peptones of normal digestion, and

* *American Drug. and Pharm. Record*, September 10, 1899.

also **cholin** and **neurin**, which are undoubtedly poisonous when they find their way into the blood and tissues. Under normal circumstances the system is quite capable of transforming the hetero- and deutero-albumose which appear at a certain stage in the digestion of albumin into peptone; but if they are produced in excess, or the process of digestion is not completed, or they exist in meat when it is eaten, they cause languor and heaviness, and probably many troubles of defective metabolism or connected with liver and nervous disease; and when the quantity of these albumoses is very great the symptoms of ptomaine-poisoning are developed.

Certain virulent poisons of a proteid nature, normal in the animal which produces them, like the poison of snakes and spiders, belong to the toxins. On the other hand, various **protective toxins**, which likewise belong to the same class, are produced in animals during an acute infectious disease, and are capable of rendering the said animal or person immune to the same disease for some time to come—**protective immunity**. It is pretty certain that ptomaines and leucomaines play an active part in most diseases of man, small portions of them floating in the blood and tissues during the course of it, and favour the termination of the disease by recovery, or so profoundly influence the nervous and other systems as to damage the patient's prospect of recovery.

THE USE OF PRESERVATIVES IN FOOD.

The preservation of animal and vegetable foods has been the means of increasing our food-supply from foreign or colonial sources. There are many ways in which foods are preserved. Beef and mutton are stored in refrigerators and sent in a frozen condition for long journeys, to be consumed as fresh meat. Beef is dried in the sun to form the 'biltong' of the Africans. Pork and fish are salted or preserved by being smoke-dried. Fruits are preserved by boiling in syrup; they are also dried and candied. When an organic substance like flesh, milk, or fruit, is heated and maintained at a boiling temperature for a few minutes all bacteria and their spores are destroyed, and the substance when enclosed in a hermetically-sealed vessel may be

kept for years free from fermentation or putrefaction. An immense industry at home and abroad has arisen from the knowledge of this fact. Large quantities of meat, fish, fruit, and vegetables, are enclosed in canisters of tinned iron plate or air-tight bottles, and boiled for an hour or two, by which they acquire a condition which one imagines may be eternal. Careless tinning or bottling leads to disasters, and adulteration of fruit and vegetables has been known to cause serious poisonous symptoms or death. Occasionally the tin has been corroded by the juices contained in the food, and a chloride or other salt of tin has been formed, which has caused irritant poisoning when the food has been consumed. Owing to defects in sealing, putrefaction may take place and ptomaines be developed.

The discovery that the heating of food in sealed vessels to the temperature of boiling water will preserve it indefinitely was made by Gay-Lussac, and the method is largely used in preparing food for the army and navy, and for various expeditions beyond the bounds of civilization. Previous to it thousands of men were lost from scurvy, owing to the absence of green food. Even now scurvy is not unknown among people who are long deprived of fresh food, and the conclusion has been arrived at that the very *freshness* of food as well as its purity is necessary to prevent disease.

Preservatives have been used to prevent the decomposition of food from early times. Salt, sugar, vinegar, oil, and spirits of wine, are those which have longest been used. But a more precise knowledge of the nature of decomposition has shown that it can be controlled by heat, cold, and chemical substances having a bacteriocidal action. How frequently food is preserved by the use of chemical agents is shown by the fact that 'out of 4,251 samples of food and drink analyzed at Somerset House in a given period, 1,659,' or more than one-third of the whole, contained preservatives. The most common in use, as shown by Dr. W. R. Smith, are the following:

(*a*) Borax and boracic acid were found in milk, 1·3 to 9 grains per pint; in cream, 10 to 97 grains; sausages, potted meat, and brawn had 15 to 66 grains per pound; butter, 18 to 65 grains; margarine, 7 to 73 grains; and bacon, 8 to 46 grains. It was also found in fish and fresh meat. The powder is often mixed for the

purpose with salt, saltpetre, or carbonate of soda, and is sometimes coloured and sold under a fanciful name. Great variation is observable in the amount, and sometimes more is used than is necessary. Butter or margarine will be well kept by 40 grains of boracic acid, with or without borax, to the pound; cream by 20 grains to the pound; and milk by 36 grains per gallon.

(*b*) Salicylic acid or salicylate of soda is used in jam or jelly, and was found in the proportion of 1·7 to 8 grains per pound; and in temperance drinks, cordials, herb-beer, cider, and foreign beer, from 1·5 to 8 grains per pint. Temperance drinks have salicylic acid in them to prevent fermentation for an indefinite time before consumption. Herb-beer is fermented with yeast, and alcohol and carbonic acid are produced, which have a preservative action. But the legal amount of alcohol is only 2 per cent. of proof spirit, so that salicylic acid is sometimes used to prevent an illegal amount of alcohol being formed in the liquid.

(*c*) Sulphite of soda, of which sulphurous acid is the active agent, is used by game-dealers, butchers, and brewers. It has likewise been found in lime-juice, ginger wine, syrups, cordials, and foreign beer, in amounts from 0·1 to 4·5 grains per pint.

(*d*) Formalin, which consists of a 40 per cent. solution of formaldehyde in water, is a powerful poison; but it is used in the proportion of 1 in 50,000 to 1 in 100,000 of milk or cream.

(*e*) Sulphate of copper is found in spinach and preserved peas to the extent of 26 grains and less per pound.

The influence of food preservatives upon the health of the consumer must be considered, for it cannot be gainsaid that a large amount of the perishable food of cities has to travel a long distance and be stored for some time, wherefore some method of preservation is necessary. The substances used in moderation over a short time only may be harmless, but a prolonged use of food containing them may cause skin diseases and gastric and nervous disturbances. The fact that such preservatives as salicin, salicylic and boracic acid, in various combinations, exist normally in some plants and fruits is no proof of their innocence or freedom from danger to the human organism, for do not strychnia, morphia, and quinine, also exist in plants? The preservatives used may be very feeble poisons, but their long-continued action in the body cannot be regarded as indifferent. With regard to formalin, it

is stated by Rideal and Fullerton that 1 in 50,000 (which is regarded as the minimum proportion efficient to keep milk wholesome for twenty-four hours) inhibits the action of the digestive ferments; and for this reason, and the fact that its detection in such small quantity is a matter of difficulty, it is considered advisable by authorities that its use should be forbidden to preserve milk, an article so essential to infants and invalids.

The amount of sulphate of copper necessary to colour green peas is small; nevertheless, it is sometimes used in excess, 26 grains to the pound having been found. Most authorities consider it injurious, but Sir Lauder Brunton states that the small quantity of 25 to 30 milligrammes likely to be obtained once or twice a week with peas is innocuous.

Neumann fed dogs with boracic acid and others with saltpetre in their food. The dogs which had saltpetre lost weight, but those which had boracic acid gained, which he concluded to prove that it did not interfere with their power of assimilation. Chittenden found that boracic acid, even up to 1 per cent., increased rather than checked the action of saliva; that it had no effect on proteid metabolism or general nutrition, and no influence on the putrefactive processes in the bowel; that doses of 3 grammes a day were so rapidly absorbed and eliminated that none could be found if the animal were killed thirty-six hours after the last dose. He therefore concluded that the continuous use of small doses of borax and boracic acid in food did not affect the health injuriously. Liebrich also states that meat preserved by boracic acid did not act injuriously. Tunnicliffe and Rosenheim agree that boracic acid favours the action of saliva, has no influence over the curdling ferment, favours gastric digestion, but inhibits intestinal (pancreatic) digestion. Their general conclusion was that small doses, up to 1 gramme per diem, did not influence proteid metabolism or assimilation in either healthy or delicate children; that borax and boracic acid are quickly eliminated, no cumulative action occurs, and they do not affect the general health. Evidence on the other side, by Rideal and Fullerton, says that 1 in 2,000, or 36 grains of boracic acid in a gallon of milk, inhibits the action of the salivary and pancreatic ferments in the digestion of starch. Mann states that boracic acid causes

diarrhœa, and Handford that 30 grains to the gallon produced delirious symptoms in infants.

A large amount of evidence was given to the Departmental Committee of the Local Government Board by experts, including Halliburton, Starling, Mann, Stevenson, Corfield, and other eminent authorities, showing the danger of preservatives in food, and that they should be prohibited, especially in those intended for infants and sick persons. The Committee thereafter made the following recommendations:

1. That formalin or formaldehyde be absolutely prohibited from use in food or drink.

2. That salicylic acid be not used in greater proportion than 1 grain per pint of liquid or pound of solid food.

3. That the use of preservative or colouring matter in milk be an offence in the United Kingdom under the Sale of Food and Drugs Act.

4. That the only preservative allowed to be used in cream be boracic acid = to 0·25 per cent.

5. That the only preservative it shall be lawful to use in butter or margarine be boracic acid or borax and boracic acid to 0·5 per cent.

6. That all kinds of chemical preservatives be prohibited from use in dietetic preparations for infants and sick persons.

7. That the use of copper salts be prohibited for colouring peas.

REFERENCES: 'Vegetarianism,' W. Tibbles, *Jour. State Med.*, June, 1904. Foster's 'Physiology,' vol. ii. *Jour. State Med.*, January, 1902. *Ibid.*, April, 1902. *Brit. Food Jour.*, 1899, i., 132. *Amer. Jour. Physiol.*, 1898, 1-39. Circular 15, U.S. Agricultural Department.

CHAPTER VII

THE FEEDING OF INFANTS

The Infant should be fed from birth with the milk of its own mother. It is unfortunate that an increasing number of women, from various causes, do not nurse their children, and the result is that artificial substitutes for woman's milk are used. It is an exceeding great pity when this happens from caprice or from the inconvenience which women attach to their having to suckle their

baby, because it detains them at home or causes them to return sooner than their wont. If each mother could be made to understand that her baby would die if it were not fed from her breast, there would speedily be a large increase in the number of breast-fed children; and when this comes about there will be a great diminution in the rate of infant mortality. Mothers must be taught how much healthier babies are when fed by the breast than when they are fed by a bottle. They will then see that their own health is built up, that they maintain their own body in a proper condition, and as a result many more women will be able to feed their babies with their own milk than do so at the present time. Unfortunately, many mothers give up the attempt to feed their children when continued effort would result in much more milk being produced. If the secretion is deficient in quantity or quality, or the milk disagrees with the baby, the cause should be sought in the mother. Perhaps she is not taking the proper quantity and kind of food, or she is unable to digest and assimilate it, or she does not drink enough; or she has constipation, leucorrhœa, anæmia, or some other ailment, which, if corrected, will probably increase the quantity and quality of the milk secreted. A small quantity of milk by no means proves the quality to be defective. Let the woman who is about to become a mother lead a rational life, keep early hours, be properly clothed, eat only plain and nourishing food, and plenty of it, take plenty to drink, attend to the condition of her stomach, bowels, and kidneys, and she will have the happy result of a better supply of good milk, and there will be less necessity for artificial means of feeding her infant.[1] [2]

It must be admitted that there are some cases in which it is absolutely impossible for the mother to feed her baby. The proper course then is to obtain the assistance of a wet-nurse or *foster-mother*. There is no substitute for mother's milk equal to that of a foster-mother. The practice of employing such has fallen into desuetude since the introduction of the bottle and other means of artificial feeding have become so fashionable. The foster-mother should be carefully selected, and there is usually plenty of time to do so. She must be healthy, and not be the subject of any disease or constitutional taint. The main objection is the cost.

ANALYSES OF HUMAN MILK.

Percentage.	Analysis given by Tanner.				Analysis by Leeds.			Wurtz's Average.	Total Average.
	Fair.	Dark.		Average.	Min.	Max.	Average.		
Fat ...	3·55	5·48	2·69	3·90	2·11	6·89	4·01	4·06	4·06
Proteids	1·00	1·62	3·92	2·18	0·85	4·86	2·05	1·67	2·36
Milk-sugar	5·85	7·12	4·36	5·78	5·40	7·92	6·99	7·05	5·26
Salts ...	0·40	0·45	0·13	0·33	0·13	0·35	0·21	0·21	0·26
Total solids	10·80	14·67	11·10	12·19	8·49	17·02	13·26	12·98	11·94
Water	89·20	85·33	88·90	87·81	--	--	—	87·02	88·06

When there is a deficiency of mother's milk for the baby, let the mother have plenty of oatmeal, milk, stout, or extract of malt. Feed the baby from both breasts at once, and let each alternate meal consist of the milk of another animal—cow, ass, mare, ewe, or goat, cow's being most readily obtained. Wynter Blyth[3] and Richmond[4] give the following percentage composition by weight of these milks *:

Composition of Milk.	Human.	Cow's.	Ass's.	Goat's.	Mare's.	Human.	Goat's.	Ass's.
Fat	2·90	3·50	1·02	4·20	2·50	1·98	3·78	1·18
Proteids :								
Casein ...	2·40	3·98	1·09	3·00	2·19	1·75	4·10	1·74
Albumin, etc.	0·67	0·94	0·80	0·70	0·15			
Milk-sugar ...	5·87	4·00	5·50	4·00	5·50	6·40	4·49	6·86
Salts	0·16	0·70	0·42	0·56	0·50	0·26	0·87	0·45
Total solids	12·00	13·12	8·82	12·46	11·20	10·39	13·24	10·23
Water ...	88·00	86·88	91·17	87·54	88·80			

Fat, proteid, and carbohydrate yield, when fully oxidized, so many calories or units of heat per gramme. The calorie-value of human and cow's milk may therefore be compared :

BLYTH'S ANALYSIS.

Human : Fat ... $2·90 \times 9·3 = 26·970$ calories.
Proteid $3·07 \times 4·1 = 12·587$,,
Lactose $5·87 \times 4·1 = 24·067$,,

Therefore 100 grammes of human milk will yield 63·624 calories.

Cows : Fat ... $3·50 \times 9·3 = 32·550$ calories.
Proteid $4·92 \times 4·1 = 20·172$,,
Lactose $4·00 \times 4·1 = 16·400$,,

The same amount of cow's milk will yield 69·122 calories.

* The *Analyst*, vol. xxi., p. 89, and xxx.

Heubner points out in his work upon Dietetics that, being fed with milk yielding an approximately equal number of calories, the child who receives the calories in the form of mother's milk will develop a much greater energy of growth than a child who is fed upon cow's milk or other substitute. He proves that better results may be obtained with a smaller number of calories derived from mother's milk than with a greater quantity in the form of artificial food ; that in artificial feeding energy is wasted in the process of assimilation, consequently it cannot be utilized in growth and building up the tissues. The additional work to be performed and the resulting increased consumption of calories is explained by the greater glandular and digestive activity required. Wasserman also proved that the assimilation of the milk of another animal entails greater secretory activity than the assimilation of milk of its own species. Neither should milk used for infants or invalids be skimmed, for by this means it loses not only fat, but lecithin. Heating milk up to 60° C. (140° F.) for half an hour also causes a loss of lecithin, which is consequently poor in organic phosphoric acid and defective as food.

THE INFANT FROM BIRTH TO SIX MONTHS.

The child's food ought to consist wholly of milk—the mother's or nurse's, if possible. If woman's milk cannot be obtained, that of the cow is the substitute which can most readily and regularly be obtained. Many attempts have been made to bring cow's to an approximate composition with human milk. From the results of many analyses, it is found that the milk of no two animals of the same or any other species agrees exactly in composition, nor do they correspond with human milk. In cow's milk, for instance, the proteids and salts are in too large a proportion when compared with human milk, and the casein is curdled during digestion in large masses of a tough and leathery character. In goat's milk, which is similar to cow's, the fat is in excess, and the casein likewise forms hard masses. Ass's milk is deficient in both proteid and fat, and, although its casein is precipitated in small flocculent masses capable of easy digestion, it is not sufficiently nutritive to allow of its being used for a long period.[5] The proteid in the curd of cow's milk is mainly **casein** ; that of woman's consists largely of **lact-albumin**, which constitutes the principal difference

in their digestibility. The sugar of milk is **lactose**, which is obtainable at a chemist's in the form of a white, dry powder. It is not so sweet as cane-sugar, and does not ferment or give rise to acidity or catarrh, like the latter does when an excess is contained in the food. It should be used whenever the addition of sugar to infants' food is desirable.

During the digestion of milk it is curdled by **rennin** of the gastric juice, and then peptonized. The curds of human, ass's, and mare's milk are small, flocculent, and easily digested and assimilated ; but that of cow's milk is deposited in masses like new cheese or putty, which are not so easily digested. Cow's milk, therefore, is liable to cause pain, flatulence, and diarrhœa, and some of the curds may pass through the bowels undigested. This is a great defect, and detracts greatly from the value of cow's milk as a food for infants. Many things have been used to prevent the formation of such large and tough curds. The best method is to mix the milk with a decoction of barley, of coarse oatmeal, or of gum acacia. These things should be thoroughly cooked by long boiling or stewing, and the liquid strained away from the residue may then be advantageously used to dilute the milk instead of plain water. The dense clotting of cow's milk is obviated by these liquids preventing the particles of casein from coming so closely together. Lime-water also acts in the same way, but it also has the effect of neutralizing the acidity of cow's milk, which distinguishes it from human. It should be added when the temperature of the milk is about 96° F., or just warm enough to drink. The addition of starchy materials, such as arrowroot, cornflour, biscuit-powder, baked flour, or other farinaceous foods, acts in the same way, mechanically preventing the formation of large, hard curds. This effect can be the only justification for the use of such foods in the early months of life, for the baby cannot digest them at such an early age. In town, probably a mixture of equal parts of cow's milk and water, with the addition of a little sugar, would make milk approximating in character to human milk, and these proportions are recommended for use. Milk should always be given to the child at a degree or two below blood heat—say, 96° F.

Pure country milk differs from the average milk delivered in town, and will bear a greater addition of water. The following

dilution of it is recommended: For an *infant under one month old*, mix together 1 part of pure country milk with 2 parts of water, adding a teaspoonful of cream and a little sugar to each meal; for children from *six weeks to four months old*, mix equal parts of milk and water; and for those *above four months*, 2 parts of milk and 1 part of water, always adding a little sugar and cream.

The quantity of food which a child should have necessarily varies with its age. During *the first week* the infant should have two tablespoonfuls every two hours—ten feedings in twenty-four hours; during *the second week* give three tablespoonfuls every two hours—ten feedings in twenty-four hours; during the *third and fourth week* give four tablespoonfuls every two hours—ten feedings in twenty-four hours; in *fifth and sixth week*, add by degrees two more tablespoonfuls to each meal, and gradually lengthen the intervals of feeding to three hours, so that the number of meals becomes eight in twenty-four hours.

During the *second month* give six to eight tablespoonfuls every two and a half hours, making $1\frac{1}{4}$ to $1\frac{1}{2}$ pints a day; during the *third and fourth month* give eight to ten tablespoonfuls every three hours—total, $1\frac{1}{2}$ to $1\frac{3}{4}$ pints a day; during the *fifth and sixth month* give ten to twelve tablespoonfuls every three hours—total, 2 pints a day.

Dr. A. A. Mussen[6] has formulated the following modification and amount of cow's milk for infants of various ages:

Age of Child.	Quantity for Twenty-four Hours.		
	Milk.	Water.	
One to two weeks	$6\frac{3}{4}$ ounces	$6\frac{3}{4}$ ounces	Each gallon should
Two to eight weeks	$13\frac{1}{2}$,,	$13\frac{1}{2}$,,	have added to it:
Two to three months	$20\frac{3}{4}$,,	$10\frac{1}{2}$,,	$2\frac{1}{2}$ ounces of cream
Three to five months	30 ,,	15 ,,	$1\frac{1}{2}$ ounces of sugar
Five to seven months, and over	36 ,,	12 ,,	$\frac{1}{6}$ ounce of salt

Artificial Human Milk.—The great trouble with cow's milk is the formation of firm, tough curds, which are difficult of digestion. This may be overcome by clotting the milk with rennet, straining off the whey, breaking down the curd, and rubbing it through a sieve, and finally mixing the two together again. But to render cow's milk most like human, the casein

must be reduced in quantity and modified in consistency, the carbohydrate increased, and the proportion of fat altered; the latter may be increased to suit the individual case. Artificial milk is usually made directly from cow's milk by the addition of cream, milk, sugar, and water. Several methods are given below:

(*a*) A simple method is to dilute $\frac{1}{2}$ pint of milk with $\frac{1}{2}$ pint of whey; add three teaspoonfuls of sugar of milk, strain, and add also two tablespoonfuls of cream.

(*b*) *Frankland's Formula.*[7]—Take of skimmed milk, $\frac{1}{2}$ pint; fresh cow's milk, $\frac{2}{3}$ pint; cream, two teaspoonfuls; milk-sugar, two teaspoonfuls. Let the skimmed milk be warmed to about 95° F., and curdled by rennet. After fifteen minutes break up the curd very finely, strain it, let the liquid portion be boiled, and add to it the fresh cow's milk, the cream, and sugar.

(*c*) *Modification of Rotch's Formula.*—Milk, 1 ounce; cream, $1\frac{1}{2}$ ounces; milk-sugar, $3\frac{1}{2}$ drachms, dissolved in 4 ounces of water; lime-water, 1 ounce; add the lime-water last, when the liquid is about 96° F., and ready to drink.

(*d*) Coulier[8] gives the following proportions: Cow's milk, 300; water, 339·5; cream, 13; lactose, 15; calcium phosphate, 1·5 grammes.

In the above formulæ the clotting power of casein is modified by the method of preparation.

(*e*) The Dresden method[9] of preparing artificial human milk is based on the average composition of human milk: Take the white of one fresh egg, mix it slowly and carefully with 13 drachms of milk-sugar, and stir into it gradually 30 ounces of water; strain it through linen into 1 pint of new milk, and mix by agitation.

(*f*) Claque gives the following formula:[10] New milk, 30 ounces; cream, $1\frac{3}{4}$ ounces; milk-sugar, $1\frac{1}{3}$ ounces; water, 18 ounces. The mixture has the following percentage: Casein, 2·7; butter, 3·8; milk-sugar, 5·0; salts, 0·5; water to 100.

(*g*) Soxhlet[11] gives the following formula for sterilized humanized milk: New milk, 30 ounces; cream, 2 ounces; milk-sugar, 1 ounce 5 drachms; water, 20 ounces. Dissolve the sugar in the water, and mix all together. Put it into bottles filled to the shoulder only; place them on the tray of a fish-kettle in water over a fire; allow them to boil for half an hour, so that the expansion of the milk may be complete; then cork

them, and boil for half an hour. The composition is: Casein, 2·6 per cent.; fat, 3·4; sugar, 4·8.

The feeding of infants in hot weather is frequently a difficult matter, especially in large towns where there is a difficulty in obtaining reliable milk. Milk is often sent long railway journeys before it reaches the consumer, and it is sometimes polluted by the unclean hands of milkers, or strainers, or cans, or by putting it in cans which have been washed with impure water; and the common method of distribution in large towns is a means of hastening fermentation and degeneration. If impure or sour milk be given to the baby it will cause vomiting, diarrhœa, or gastro-enteric catarrh, which may end fatally. Exceptional care must be taken that the bottle is kept scrupulously clean. For this purpose a bottle of the simplest character is the best—just a glass vessel with a teat over one end and a stopper at the other. The long tube and complicated fittings so long in vogue could never be kept clean. This is the time when **sterilized milk** is useful. It should be sterilized as soon as possible after milking. A simple method is as follows: Put the milk into clean bottles and cork them loosely, with a wire or cord over the cork; let the bottles be now put into a vessel of water and boiled for twenty minutes; at the end of the time take them out, and fix the cork in firmly. By the application of heat all bacteria are destroyed, but only enough milk for one day's supply should be boiled at once. Large dairy companies undertake to supply such milk from their farms. Milk boils at 233° F., but it may be **pasteurized** by keeping it at a temperature of 176° to 185° F. for about half an hour, and this is considered by many authorities to be sufficient cooking and protection.

Sometimes it is necessary to stop all milk food during a bad attack of diarrhœa, vomiting, or gastro-enteric catarrh. Its place must then be supplied by **albumin-water**, made by beating up the white of an egg in $\frac{1}{2}$ pint of sweetened water and adding a little salt; chicken, mutton, or veal broth freed from fat, raw meat-juice, or other meat-juice and water, may also be given. Albumin-water is the best of these, but even that is not a typical food, and the others are very deficient in nourishment, and are, therefore, only temporary foods.

The proof that a child is thriving is best established by its

increasing in weight from week to week, and its average increase should be 1 pound per month. The same scales and similar clothing should always be used. A written report ought to be kept. Girls are a little lighter than boys.

The average weight of a healthy male child

At birth is	6·8 pounds.	At six months is	12·4 pounds.
At one month is	7·4 ,,	At nine months is	15·8 ,,
At two months is	8·4 ,,	At twelve months is	18·8 ,,
At three months is	9·6 ,,		

We are living in an age when *artificial foods* and modifications of cow's milk made in the chemical laboratory are held out as being quite as safe and satisfactory as human milk. *They are not, and never can be made, so satisfactory as the milk of a healthy woman.* The people who try to prove that bottle-feeding is as good as, nay, preferable to, breast-feeding do not realize the enormous death-rate amongst artificially-fed children as compared with that of children who are fed with a woman's milk; nor do they realize the immense amount of non-fatal sickness among artificially-fed children, mainly of the nature of marasmus, scurvy, rickets, and diseases of the alimentary canal. There is a good deal of talk at the present time about "the degeneration of the race" and means for improving it; but inasmuch as a large basis for the degeneration consists of the artificial feeding of young infants, it is at this point where improvement must be urged, for we may date from this period many of the causes of our young men and women growing up weak and debilitated, of stunted growth and weak vitality, and unfitted for the race in life as compared with the stronger and healthier offspring of a woman who has led a normal life, and who has in consequence given her child human milk of good quality, and laid for it a good foundation upon which the superstructure of manhood and womanhood is to be built.

THE DIET OF AN INFANT FROM SIX TO TWELVE MONTHS OLD.

The quantity of food must be increased with the child's age and growth. In the *fifth and sixth month* it requires about 2 pints in twenty-four hours; in the *seventh and eighth* it should have ten or twelve tablespoonfuls every three hours, or 2 to $2\frac{1}{2}$ pints a day; in the *ninth and tenth* each meal should be 8 or 9 ounces—that is,

sixteen or eighteen tablespoonfuls about every four hours, or six meals a day, with a total of $2\frac{1}{2}$ to $2\frac{3}{4}$ pints; in the *eleventh and twelfth* each meal may be $\frac{1}{2}$ pint, twenty tablespoonfuls, making a total of 3 pints in twenty-four hours. *At one year* the daily diet should include 35 to 40 ounces of milk—say 2 pints—which may be mixed with various articles, as biscuit-powder, rusk, fine oatmeal or porridge, baked flour, semolina, arrowroot, patent malted or other farinaceous food, and a little milk-pudding, egg, gravy, beef-tea, mutton, veal, or chicken broth, and a very little bread, may be given in suitable proportions to vary the diet.

A little *variation in the diet may begin to be made at six months* of age, but it must be done gradually. A child cannot digest food containing starch until the secretion of salivary and pancreatic fluids begins; these secretions do not contain the digestive ferments at first, and when they *begin* to appear, the proportion is small.* It is not until the child has got several teeth that the saliva is sufficiently active to do any good; it is therefore unsafe to add starchy or farinaceous material to the diet until then. Then we may allow at first a single meal a day of baked flour, semolina, fine oatmeal, or a patent food. Bread and potato must not be given at this early age; they contain too much starch, and are responsible for many digestive troubles in infants. Now, when flour is submitted to heat by baking it in an oven the starch granules are burst asunder and some of the starch is converted into dextrin, by which means it is more readily digested than bread; hence baked flour is preferable to bread-pap or mashed potato. Oatmeal porridge made of fine oatmeal is more valuable really than flour, being richer in proteid, fat, and iron salts. It must be cooked slowly for about four hours.

Baked flour or **oatmeal** is prepared thus: Spread the meal thinly upon a dish, put it in a slow oven to bake, and stir it occasionally until the whole is a biscuit colour; break it into a powder with a rolling-pin or pestle and mortar, pass it through a

* If there is any scientific excuse for the use of the hard rubber pad which teething children are given to bite and exercise their jaws upon, it is that it encourages a flow of saliva. That abomination called a 'dummy-teat' has no excuse for its existence. On the other hand, it deludes the child into imagining that it is getting some food, and the constant sucking causes acidity of the stomach, flatulence, indigestion, pain, colic, and other evil consequences. The folly of giving such an article to an infant a few days old must be evident to any intelligent person.

sieve, and keep the fine powder in a covered tin ready for use; reject the coarse particles. When it is required, mix a teaspoonful with as much sugar and a little salt into a smooth paste with water, and gradually add four tablespoonfuls of water; pour upon it $\frac{1}{2}$ pint of boiled milk; stir it briskly; boil it for ten minutes. It is ready when cool enough to drink.

Malted foods have a saving grace which prevents their banishment along with bread, rice, potato, and other farinaceous foods, from the child's dietary, for malt contains an enzyme (*diastase*) by means of which it will convert its own weight of starch into sugar. Malted foods may therefore be given earlier in life than the aforesaid substances. Of course, milk is not by any means replaced by malt, and will be mixed with the food according to directions given. In some foods of this class there is *no starch*, the carbohydrate being represented only by milk-sugar, maltose, and dextrin, which may, therefore, be given from early days, mixed with cow's milk, if the mother's milk is deficient or absent.

At the age of *about nine months* the child may have a tablespoonful or two of beef-tea, mutton, veal, or chicken broth, or a tablespoonful of gravy from a joint, with a little bread or dry toast soaked in it, or about a quarter of a well-whipped egg may be given in milk every other day. If these meat-juices or broths cause diarrhœa, or otherwise disagree, which they are at first apt to do, they should only be given occasionally and in smaller quantity until toleration is established.

Very few children are fed properly; they are too often encouraged to seek bits from nurse's or mother's plate, which is the greatest possible mistake. It is very dangerous to feed children with odds and ends of bread-and-butter, biscuit, bun, potato, banana, grapes, and other fruit or substances, at such an early age; it is almost certain to end in disaster, although, it is true, some children will thrive on anything.

THE FOOD OF A CHILD FROM ONE TO TWO YEARS OF AGE.

It is estimated that at eighteen months old a child requires the following proportion of the dietetic proximate principles: Proteid, 1 part; fat, 1·5 parts; carbohydrate, 8·5 parts; and the total is about three-tenths of the food of a man doing ordinary work. It

should consist of 2 or 3 pints of milk a day, made up with a patent food, oatmeal, milk-pudding, a little bread-and-milk, and milk to drink. By this means the large proportion of carbohydrate is readily supplied from the starch and sugar they contain. Potato ought to be given, or soup in which a fresh vegetable, such as carrot, parsnip, turnip, or celery, has been boiled once every day, to supply the organic salts and the fresh juices which are so necessary for their antiscorbutic properties. At this age we may also give each day a little fresh fruit, as orange, grape, banana, or baked apple, taking great care to remove skin and pips. The value of fruit, like vegetables, is almost entirely due to the salts contained in them, which are so necessary for the proper constitution of the blood and tissues. It should not be forgotten that babies require something to drink besides milk; the latter does not sufficiently quench their thirst, and the child is apt to become thirsty, fretful, and feverish, or be constipated. **Cold water** is the best drink for babies, and a tablespoonful or two should be given once or twice a day; it flushes the tissues and washes out débris which may be a cause of fretfulness and feverishness. Constipation is often remedied by draughts of water; if it is not, the food should be varied; give less bread and other starchy food, more oatmeal and fruit, and use manna, treacle, honey, or Demerara sugar, as a sweetening material.

At eighteen months the daily dietary should be similar to the following—Breakfast, 8 a.m.: Oatmeal porridge, with 8 or 10 ounces of milk. Lunch, 11 a.m.: Bread-and-milk or patent food, 6 or 8 ounces of milk. Dinner, 2 p.m.: Soup or gravy with bread, a little potato, vegetable marrow or cauliflower, a little very finely cut meat or minced fish, milk pudding or custard. Tea, 6 p.m.: As breakfast. Milk or water to drink at each meal.

At two years, or when the child has got all its teeth, the dietary may be similar to the following—Breakfast: Milk ½ pint as porridge or bread-and-milk, a little bacon fat or boiled egg. Dinner: Soup which has had vegetables boiled in it, 2 ounces of boiled fish or minced meat, potato, cauliflower, vegetable marrow or spinach, milk pudding, breadcrumb pudding, water to drink. Tea: Milk ½ pint as porridge or bread-and-milk, bread-and-butter 5 ounces, jam, treacle, fruit.

The above two dietaries give a selection by which the character

of the food may approximate to that of the adult. The transition must be by gradual and easy stages : children are unable to digest heavy food.

RICKETS AND SCURVY.

Before closing this chapter attention should be drawn to the frequency of ailments among young children which arise from errors in feeding during early life. It is the greatest possible mistake to suppose that anything which is soft enough for the toothless gums of children is suitable food ; or to imagine that bread-and-milk, arrowroot, biscuits, sponge-cakes, and many similar things, are digested as well as other foods just because they are soft. Even some patent foods are not correct ; they contain too much starch, and not enough fat and proteid or flesh-forming food, and the salts required for the blood and tissues are deficient. Flour, which contains 70 per cent. of starch, is the basis of many farinaceous foods, and, like sago, arrowroot, and semolina, contains too much starch in proportion to the proteid ; consequently the child is gradually starved. *Thousands of children are starved on starch*, though they appear to be abundantly fed, because the food is deficient in proteids and salts. This is a prolific source of *rickets*. Another point in the causation of rickets and scurvy in infants is the want of *freshness* in the food, be it milk or other article. Freshness is as essential as purity. Condensed and sterilized milk lack the antiscorbutic properties of fresh cow's milk or human milk, and do not give life and vitality like them. When condensed or sterilized milk is used the infants, even of wealthy people, sometimes suffer from the old-fashioned scurvy, which used to be common, and is even now sometimes seen among adults who are deprived of fresh food and vegetables for a long time.

Cases of scurvy-rickets present a combination of the symptoms of both complaints. The child loses colour, is weak, languid, drowsy, and apathetic ; the little mite may have swollen and spongy gums, and usually has flying pains in the loins, limbs, or joints, and indurated swellings in various parts of the body, such as the front of the legs, behind the knee, or about the elbow, due to hæmorrhage beneath the periosteal covering of the bone or deep fascia. The ends of the bones may be swollen, and occasionally crepitus indicates a separation of the end from the shaft. The association of rickets with the foregoing symptoms of scurvy is

indicated by the child being very restless at night; he throws off the bedclothes; the head sweats very freely, and he tosses it about and rubs it upon the pillow so much as to cause a bare patch at the back of it; the limbs are tender, and the child screams when picked up. A careful examination may reveal other signs of rickets, as thickening of the ends of bones, particularly of the epiphyses of the radius, ulna, or tibia, which causes the joints to appear swollen; the ribs may be beaded; there is a delay of some months in cutting the teeth; the bones of the head do not grow and close the fontanelles as soon as usual; the child is either unable to stand, or his legs become 'bowed' by his attempts to do so, and if he creeps much about the floor the bones of his arms may become correspondingly bent.

The prevention and cure of the disease are the same—viz., to feed the child with good fresh cow's milk, diluted with one-third of plain water, barley-water, oatmeal-water, or lime-water, and always adding cream and sugar, as before recommended in early feeding of infants. The following is thought to be enough for a child of nine months for a day's supply: Take fresh cow's milk, 15 ounces; cream, 5 ounces; water, 15 ounces; lime-water, 5 ounces; sugar of milk, three or four teaspoonfuls. Let the milk, cream, water, and sugar, be boiled together for two or three minutes to sterilize it; cool it quickly, add the lime-water when only warm, stir well together; bottle it and keep in a cool place; warm each meal when it is wanted. This will make five meals of 8 ounces each, which should be given at three and a half or four hours apart. Give in addition one meal a day of whipped-up egg, gravy, or broth, in which a vegetable has been boiled, making six meals in twenty-four hours.

If the child is a year old, he should have potato soup or a small steamed potato made into gruel with milk. A little vegetable marrow, baked apple, one or two crushed strawberries, a teaspoonful or two of orange juice or other fruit juice, should also be given once a day.

The child will be more comfortable, his body cooler and less painful, and he will sleep better upon a hair-mattress than a feather-bed. His sleeping-gown should be so long that he cannot uncover his legs. His bedroom must be well ventilated, but free from draughts. Let him have a daily bath of salt-water, followed

by gentle friction of the entire body ; be taken into the open air every day in a perambucot, providing it is neither damp nor foggy. A cold, dry wind is not so deleterious if the child is well wrapped up as damp or fog. He should be discouraged from attempts to stand or walk until the bones become firmer. The parent need not be over-anxious about existing curvatures, for it is quite probable that they will very largely disappear about the period of puberty, when Nature very wisely remodels the bones.

FEEDING OF CHILDREN AFTER THE PERIOD OF INFANCY.

The feeding of children is an exceedingly important matter, because the processes of growth and metabolism are going on very actively.

Metabolism is the process by which the physiological balance of the healthy organism is maintained. Through it the elements of our food are assimilated and converted into living flesh and blood. Under its influence are eliminated the waste materials of the tissues, the blood is purified, and a healthy action of the glands and organs maintained. By it the body is built up, animal fuel is stored for purposes of combustion, and the potential energy of the food is converted into the kinetic manifestations of heat, muscular power, nerve force, and all the other manifestations of a living organism. Metabolism is, therefore, constructive and destructive, and each of these processes is exhibited more actively in children and growing youths than in adults or elderly people. For this reason children require an abundance of food, and it is estimated that the daily dietary of children from *ten to fifteen years* of age should contain—proteid 79, fat 35, and carbohydrate 251 grammes per diem.* *Atwater* states the proportion of a man's food required by children at various ages to be as follows :

A child under two years requires 0·3 of the food of a man doing ordinary work.

A child of three to five years requires 0·4 of the food of a man doing ordinary work.

A child of six to nine years requires 0·5 of the food of a man doing ordinary work.

* Camerer's dietary, which is considered sufficient for a youth of sixteen years, includes—proteid, 75 ; fat, 42 ; and carbohydrate, 325 grammes per diem, yielding energy equal to 2,040 calories.[12]

A child of ten to thirteen years requires 0·6 of the food of a man doing ordinary work.

A girl of fourteen to sixteen years requires 0·7 of the food of a man doing ordinary work.

A boy of fourteen to sixteen years requires 0·8 of the food of a man doing ordinary work.

Very erroneous ideas have prevailed as to the amount and quality of food which is required by growing children, and there can be little doubt that one of the chief causes of degeneracy among young people is to be found in the insufficient food which many of them get during this important period of their life. Children digest quickly, and their respiratory activity is very great, even when they are at rest; for this reason they should be allowed about as much carbohydrate as an adult, and an ample supply (about three-quarters of the amount allowed for an adult) of proteid is necessary for their tissue formation. The latter can be derived from any of the foods in the nitrogenous class—*e.g.*, meat, fish, eggs, milk, cheese, peas, beans, lentils, and others—the cost of which varies, vegetable being cheaper than animal proteid. We therefore highly commend the use of peas, beans, lentils, and haricot beans in the form of soup, purée, or as a more solid repast when economy has to be practised; but it is considered that they cannot altogether replace meat, fish, and milk. With regard to milk, also, it is a most valuable diet for children; but there is in it a most remarkable deficiency of iron, which is so necessary for making blood: hence milk must not be used for totally replacing meat, but rather to supplement it. Eggs contain more iron than milk, and are useful for that reason. There is scarcely any ordinary article of food so rich in iron as oatmeal, and its mixture with milk makes an almost perfect food, and is of the greatest value for growing children. Green vegetables are very necessary to children, and they contain the iron-bearing chlorophyll as well as salts essential for the blood and tissues. Carbohydrates are very necessary in abundance, together with fat, to assist in forming the young tissues, and to supply the carbon which will be oxidized during their great metabolic activity; for this they may be allowed as much bread-and-butter or other fat as they can eat in reason, with jam, marmalade, honey, or treacle.[13]

As children digest quickly, the intervals between their meals should not be very long. If, for instance, they have breakfast at 8 a.m. and dinner at 1 p.m., they should have a lunch of milk with bread and jam about 11 o'clock, their tea at 4 p.m., and supper about 7 o'clock. Children of ten years should be in bed by 7 or 8 p.m., and up to fifteen years they ought never to be up after 10 p.m.

When writing upon the causes of the degeneration of the race, Dr. Niven said that the gain in wealth to the community by passing children on to the working period in a condition of physical efficiency would be so enormous as to quite justify the additional immediate burden upon the rates which would be involved if poor children were fed at school at the public cost, which he considers they ought to be.* He estimates that a child of seven years requires daily 62·5 grammes of proteid and 1,750 calories of energy for full efficiency, to supply which he gives the following three meals as a sample of how such food may be provided economically for children in Board or Council schools:

First meal: Consisting of 2 ounces of oatmeal and 2 ounces of sugar in porridge. Taking the composition of oatmeal as proteid 14·5 per cent., fat 10, carbohydrate 65, and the sugar as 95 per cent. carbohydrate, the meal contains 8·16 grammes of proteid and 5·62 grammes of fat, and will yield 287·5 calories—that is, one-eighth of the proteid and one-sixth of the total energy required for the day.

Second meal: 1 pint pea soup, containing 4 ounces of peas, with $\frac{1}{2}$ pound of bread. This contains 38·6 grammes of proteid and 4 grammes of fat, and yields 987·5 calories.

Third meal: $\frac{1}{2}$ pound of bread and 1 ounce of margarine or other fat will contain 15 grammes of proteid, and yield 804·6 calories.

The three meals form practically a complete dietary; it is rather poor in fat, which, however, may be increased in the second meal.

The London Hospital allows for children:

(*a*) Bread, 8 ounces; milk, 1 pint; beef-tea, $\frac{1}{2}$ pint (made from 4 ounces of beef); or

* *Farthing dinners* were instituted in Birmingham for poor children in 1886. The rationale was based on the value of legumes. The meal consisted of soup made of peas, beans, lentils, or maize; of bread-and-milk or cocoa with bread-and-jam. The actual cost averaged 0·45d. per head.

(*b*) Bread, 8 ounces; potatoes, 6 ounces; meat, 2 ounces milk, 1 pint per day.

The Children's Hospital has dietaries for various conditions:

(*a*) **Milk diet**: Bread, 6 ounces, with butter; milk, 2 pints; rice or other milk pudding.

(*b*) **Broth diet**: Bread, 7½ ounces, with dripping or butter; milk, 1¼ pints; mutton broth, ½ pint.

(*c*) **Beef-tea diet**: Bread, 5 ounces, with butter; milk, 1½ pints; beef-tea, 13 ounces.

(*d*) **Fish diet**: Bread, 8 ounces, with butter or treacle; boiled sole, 2½ ounces; mashed potato, 3 ounces; milk, 1 pint, or milk ½ pint and cocoa ½ pint.

(*e*) **Meat diet**: Bread, 6½ ounces, with butter, dripping, or treacle; meat, 2½ ounces; mashed potato, 4 ounces; milk, 1 pint, or milk ½ pint and cocoa ½ pint.

Children at school should, if they rise at six or seven and do a lesson before breakfast, be allowed a glass of hot milk, or coffee or cocoa with plenty of milk, as soon as they get up. Their breakfast at 8 or 8.30 should consist of porridge or hominy, followed by fish, egg, bacon, ham, tongue, or cold beef, plenty of bread-and-butter, jam, and marmalade being allowed, with tea or coffee or hot milk and water. Dinner at 1 or 1.30 should consist of meat, haricot beans, pea soup or lentil soup, potatoes and green vegetables, turnips, carrots, tomatoes, leeks, or onions, in turn. Puddings, such as milk puddings, are very easily digested, and suitable for many delicate children, but they are soon digested, and leave a sense of hunger; boiled pudding containing fresh or dried fruit, or plain suet pudding, with jam, marmalade, or treacle, are more suitable for the majority. Tea at 4 for younger children, and at 5 or 6 for older ones, should consist of plenty of bread-and-butter or dripping, with jam, marmalade, or treacle; watercress, lettuce, green onions, or celery; tea or hot milk and water. Supper at 7 or 8 may consist of soup, porridge, hominy or milk pudding, together with bread-and-butter with jam or marmalade. Good bread should be the basis of all these meals, and whole-meal bread is better than that which is made of superfine white flour; porridge of oatmeal or cornmeal is very important; and all farinaceous and saccharine foods must be freely allowed to supply heat and

force, and they are usually more easily digested than fat. Fat is a very important article, and may be taken in the form of meat, bacon, ham. But some children cannot eat these articles; they, however, usually like plenty of butter and dripping, and will frequently eat boiled puddings in which the suet will easily take the place of fat meat. Great care is then necessary that the suet is finely minced, for visible suet is as objectionable to them as fat meat. Meat should be allowed twice a day, in the form of eggs, fish, bacon, ham, sausage, tongue, beef, mutton, or fowl—the lighter kind for breakfast, the heavier or more solid kinds for dinner. The youngest boys need about $3\frac{1}{2}$ to 4 ounces a day; boys of nine or ten years, about 6 ounces; and youths of fifteen or sixteen years, about 9 ounces of *cooked* meat, free from bone, per day. Clement Dukes, in 'Health at School,'[14] recommends a provision of 1 pound of uncooked meat (including bone) for boys of fifteen or sixteen, and $\frac{3}{4}$ pound for boys of ten to fifteen years. Fruit and green vegetables should not be forgotten.

The question of drink cannot be overlooked. Children want plenty to drink, as a rule, and they may be allowed plain water, milk or milk and water, lemon-water, barley-water, aerated drinks, weak tea, coffee or cocoa, with their meals. Children who eat badly will usually consume more food if they drink plenty with it; and in a case where milk is an important part of the diet they will usually drink more of it if they have it with solid food. The question as to whether alcohol in any form should be allowed is not a mere matter of sentiment; briefly, *children do not need it.* At some public schools table beer is allowed the boys; at others they are permitted to buy **shandy-gaff** (a mixture of beer and lemonade in equal proportions.) The least evil of the two is to provide it with the dinner or supper, when it may be drunk under the eyes of the masters; this is better than allowing the boys to purchase an unlimited amount of shandy-gaff. In either case it may be the foundation of future intemperance, and should be discouraged; but some parents insist on the allowance of beer or port wine, and have even sought medical certificates to back up their view of its necessity.

NIGHT TERRORS.

One of the effects of wrongly feeding children is the trouble known as 'night terrors,' which may occur to any child, and

is not uncommon in children of ten to thirteen years of age. The attack causes the child to awaken suddenly, usually out of his first sleep, with a shriek as if seriously hurt. He sits up in bed with an appearance of great terror depicted on his countenance; he is pale or flushed, and a cold perspiration stands upon him; he clings convulsively to his nurse, but cannot be comforted, and he is unable to explain what is the matter with him or what frightened him. It is probable that he has had a bad dream or nightmare, and that for the time he is genuinely delirious, for he fails to recognise either his relatives or surroundings. The attack passes off in a few minutes. The trouble usually occurs only to highly-strung or nervously-disposed children, in whom the pupils dilate from the slightest cause of fear or excitement. A careful inquiry into the character of the food, or what has been eaten independently of the meals, will elicit the fact that it is in some way unsuitable; it may be that too much cake, currants, sweets, or raw fruit, is being consumed. Careful regulation of the diet will usually prevent a recurrence of the trouble; if it does not, an inquiry should be made into the number of hours of study, especially of home-work; for a continuance of the nervous condition which caused the 'terrors' may be a predisposing cause of epilepsy or chorea.

It behoves all parents, heads of schools, and committees, to be exceedingly particular as to the quality and quantity of food supplied to young people during the period of growth, which is also that of the greatest physiological activity. There can be little doubt that a great cause of ill-health or degeneracy of young persons is to be found in the insufficiency of food upon which they have to perform the hard work of school life. It is to be feared that the average parent thinks little of the feeding of his children, especially when they are away from his roof—at a boarding-school, for instance; but it behoves him to inquire most particularly into this matter, for it is upon him that the duty devolves to see his child fed in such a way as to enable him to reach the highest possible physical and mental development. The children in orphanages and similar institutions are those most likely to suffer, because of the cost of animal food; but surely it is a degradation of charity merely to provide a roof for a child, while its body and mind are being starved. The feeding of children is of immense importance to the State, for in the

race for life the well-nourished will generally beat the badly-nourished ones. The well-nourished and sound of body are those best capable of advancing themselves and assisting in the betterment of others; while bad feeding, which is part of a general deficiency in training, aids in the physical and moral degeneration of the race.

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CHAPTER VIII

THE DIET OF HEALTHY ADULTS

THIS has been largely considered when discussing the value of food to the body in a previous chapter.

Ranke, a man of average size and weight, found that he maintained his health, strength, weight, and nitrogenous equilibrium, during the ordinary circumstances of life, upon a diet containing 100 grammes of proteid, 100 of fat, and 240 of carbohydrate per diem, which may be taken as constituting a *normal diet*. These amounts can be obtained from many combinations of food, but the three following examples serve to show how they may be obtained from the simplest articles:

(*a*) 17 ounces of lean meat, 4 ounces of fat meat or butter, 17 ounces of bread.

(*b*) 8 ounces of lean meat, 2 ounces of butter, 28½ ounces of bread.

(*c*) 12 ounces of meat (fat and lean) and 2 pounds (32 ounces) of bread.

Moleschott, who made numerous experiments, recommended a diet for men doing ordinary labour which contained 130 grammes of proteid, 84 of fat, 404 of carbohydrate, 30 of salts, and 2,800 of water. These amounts are moderate, and, although not equal to

the figures of some modern investigators, are believed to be sufficient.

The *normal diet* would be such that the body is maintained in health, neither gaining nor losing weight, and the income and expenditure of the body are properly balanced. There is a personal equation in the matter, which may influence the calculation of the normal diet of an individual. At any rate, it must contain a *minimum* of carbon to yield 900 grammes of carbonic acid gas —*i.e.*, 245 grammes (about 3,780 grains) of carbon; it must also contain enough proteid to replace the tissue proteid worn out daily by wear and tear of the bodily machinery. The *minimum* cannot be easily calculated, but it probably cannot fall below 45 grammes (695 grains) of proteid, which will yield 15 grammes (231 grains) of urea, and is little more than the amount excreted by a starving man; as a matter of fact, men find they can work best with a daily consumption of 100 grammes of proteid, yielding 33 grammes of urea. We have seen that the chief proteid is the albumin of meat and fish, and the chief carbohydrates are starch and sugar.[1] Starch and other carbohydrates form a large part of all cereals and vegetables, and from these heat and energy are derived; a diet, therefore, which is deficient in these sources of carbohydrate is physiologically wrong. Fat is necessary, in the form of fat meat, butter, cream, etc. We might expect, from the relationship of fat and carbohydrate, both being composed of the same elements, that proteid and starch would form a normal diet, and fat would be unnecessary; but experience proves that the body is not maintained in health without fat.[2]

Man is an omnivorous animal, and can derive force and heat from any food; and as the body soon adapts itself to its food, very few rules can be laid down. As a general rule, people in good circumstances eat more meat and less bread than the working classes, who can less afford it, and consequently eat more bread and less meat. The food in the dietaries of public institutions usually contains more carbohydrate than proteid food, because of the advantage in price, carbohydrate being decidedly cheaper; but, as already stated, the proteid in peas, beans, and lentils is cheap enough, and ought to be more freely used when animal food is deficient.

Halliburton[3] says that a man doing *ordinary work* eliminates

250 to 280 grammes of carbon a day as carbonic acid gas, and 15 to 18 grammes of nitrogen as urea, and has arranged the following dietary as one which will provide these elements on the higher scale—viz., 20 grammes of nitrogen and 300 grammes of carbon, from 135 grammes of proteid, 97 of fat, and 413 of carbohydrate :

	Quantity.		Grammes of—					
	Grammes.	Ounces.	N.	C.	Proteid.	Fat.	Carbohydrate.	Salts.
Lean meat	250	9	8·0	33	55	8·5	0	4·0
Bread ...	500	18	6·0	112	40	7·5	245	6·5
Milk ...	500	15	3·0	35	20	20·0	25	3·5
Butter ...	30	1	0	20	0	27·0	0	0·5
Fat meat	30	1	0	22	0	30·0	0	0
Potatoes ...	450	16	1·5	47	10	0	95	4·5
Oatmeal ...	75	3	1·7	30	10	4·0	48	2·0
			20·2	299	135	97·0	413	21·0

Ranke, who experimented on his own body with a dietary on the lower scale, and which he found to be ample for his physiological requirements, formulated the following balance-sheet :

Income.			Expenditure.		
Food.	Nitrogen.	Carbon.	Excretions.	Nitrogen.	Carbon.
	Grammes.	Grammes.		Grammes.	Grammes.
Proteid, 100 ...	15·5	53·0	Urea, 31·5 ; uric acid, 0·5 ...	14·4	6·16
Fat, 100	0	79·0	Fæces	1·1	10·84
Carbohydrate, 250	0	93·0	Respiration (CO_2)	0	208·00
	15·5	225·0		15·5	225·00

If a man live upon lean meat (**proteid**) alone, he either takes too much nitrogen or too little carbon. The latter must then be derived from his body, and result in emaciation. This method of treating obesity may be counteracted by the formation of fat from proteid. If a man live on fat alone, the nitrogen must be derived from his tissues. If he live on carbohydrate alone, the nitrogen must again be derived from his tissues, and so far as this element is concerned he suffers from inanition. But when

carbohydrate and fat are taken along with meat, they spare the consumption of proteid.

During metabolism the food which is being consumed gives out heat. Each unit of heat is called a **calorie**, but the value of this unit and the amount of heat given off by the oxidation of food differs slightly, according to various authorities. Ranke reckoned that 1 gramme of proteid gave rise to 4,000 calories of heat, the same amount of fat to 9,069, and of carbohydrate to 3,898 calories, and formulated therefrom the following balance-sheet :

HEAT PRODUCED.

Proteid ...	100 grammes × 4,000 = 400,000	calories.
Fat	100 grammes × 9,069 = 906,900	,,
Carbohydrate ...	250 grammes × 3,898 = 974,500	,,
	2,281,400	

HEAT DISCHARGED.

By warming food	65,000	calories.
By warming air in lungs	96,000	,,
By evaporation of water in lungs ...	366,660	,,
By radiation and evaporation from the skin	1,753,740	,,
	2,281,400	

The following examples of daily allowances show how the proportion of proximate principles have been distributed in public dietaries for adult male persons :

(*a*) Bread, 1 pound ; cooked meat, 8 ounces ; potatoes, 8 ounces ; butter, 1 ounce ; sugar for tea, 1 ounce ; 2 pints of tea with milk ; 2 pints of beer.

(*b*) The average full or ordinary diet of various London hospitals includes proteid 100, fat 50, carbohydrate 360 grammes, distributed as follows : Bread, 12 ounces ; butter, $\frac{3}{4}$ to 1 ounce ; milk, 10 ounces ; meat, 6 or 8 ounces ; potatoes or fresh vegetables, 8 ounces ; oatmeal gruel with milk or beef-tea, 1 pint ; milk or bread pudding, 8 ounces ; sugar, 1 ounce ; and tea or coffee. Beer or porter, 1 pint a day, when ordered.

(*c*) St. Mary's Hospital, London, allows the following ordinary diet—Breakfast, 6 a.m. : Tea, coffee, or cocoa, with sugar, 1 pint ; milk, $\frac{1}{4}$ pint ; bread-and-butter. Dinner, 12 noon : Meat, 4 ounces ; potatoes or fresh vegetables, 8 ounces ; bread. Tea, 4 p.m. : The same as at breakfast. Supper, 7 p.m. : Beef-tea, or milk or cocoa, 1 pint ; bread-and-butter.

(*d*) St. George's 'ordinary diet' includes: Bread, 12 ounces; butter, 1 ounce; meat, 3 ounces; potatoes, 8 ounces; milk, ½ pint; porter, ½ pint; gruel, 1 pint; sugar, 1 ounce; tea or coffee.

(*e*) A New York hospital[4] provides this 'daily house diet'—Breakfast: Oatmeal or hominy; tea or coffee, with milk and sugar; bread-and-butter. Dinner: Potatoes, bread-and-butter, and one of the following: turnips, sweet potatoes, beet-root, spinach, squash. Supper: Tea, milk, and sugar; bread-and-butter; fresh or preserved fruit. The following articles are served in addition with the meals mentioned:

Sunday: Breakfast, eggs; dinner, roast-beef and corn-starch* pudding.

Monday: Breakfast, baked potatoes; dinner, soup, stewed beef or mutton, rice-pudding.

Tuesday: Breakfast, mutton chop; dinner, pea soup, roast mutton, bread pudding.

Wednesday: Breakfast, potatoes fried or stewed; dinner, roast beef, corn-starch pudding.

Thursday: Breakfast, eggs; dinner, soup, beef, or mutton, tapioca pudding.

Friday: Breakfast, mackerel or codfish; dinner, bean soup, baked fish, rice pudding.

Saturday: Breakfast, beefsteak; dinner, corned beef, cabbage, bread pudding.

(*f*) The British Army allows per day for each man—Bread, 680 grammes (24 ounces); potato, 453·6 grammes (16 ounces); fresh vegetables, 226·8 grammes (8 ounces); meat, 340·2 grammes (12 ounces); fresh milk, 99·2 grammes (3½ ounces); sugar, 42·5 grammes (1½ ounces); salt, coffee, and tea, each 7·1 grammes (¼ ounce).

(*g*) Parkes suggested the following as a war ration for British soldiers.[5] It contains 5,000 grains of carbon and 380 grains of nitrogen: Bread, 20 ounces; potatoes and green vegetables, 16 ounces; fresh meat, without bone, 16 ounces; sugar, 2 ounces; peas or beans, 3 ounces; salt, ½ ounce; cheese, 2 ounces; pepper, $\frac{1}{20}$ ounce; tea, ½ ounce; coffee, 1 ounce; and beer, 1 pint, or red wine, ½ pint.

* Derived from Indian corn or maize.

(*h*) The daily ration of French soldiers includes: Bread, 1,000 grammes, or 32 ounces; fresh vegetables, 100 grammes, or $3\frac{1}{2}$ ounces; meat, 300 grammes, or $9\frac{3}{4}$ ounces; sugar, 25 grammes, or less than 1 ounce.

(*i*) The daily ration of German soldiers includes: Bread, 750 grammes, or $26\frac{1}{2}$ ounces; potato, 2,000 grammes, or 64 ounces; meat, 250 grammes, or $8\frac{3}{4}$ ounces; rice or barley, 125 grammes, or $4\frac{1}{2}$ ounces; beans, 340 grammes, or 12 ounces; salt, four teaspoonfuls; coffee, four teaspoonfuls.

(*j*) The British Navy[6] allows the following ration per man for each day: Bread, 680 grammes, or 24 ounces; or biscuits, 567 grammes, or 20 ounces; meat, 340 grammes, or 12 ounces; vegetables and potato, 453·6 grammes, or 16 ounces; flour, 256 grammes, or 9 ounces; condensed milk, 21·2 grammes, or $\frac{3}{4}$ ounce; sugar, 85 grammes, or 3 ounces; jam, 57·7 grammes, or 2 ounces; coffee and tea, 21·2 grammes, or $\frac{3}{4}$ ounce; salt, 7·1 grammes, or $\frac{1}{4}$ ounce; rum, 72 grammes, or $2\frac{1}{2}$ ounces.

(*k*) The Mercantile Marine in 1893 allowed the following weekly ration per man, which is compared with the Admiralty allowance of the same period:[7]

	Mercantile Marine.			Admiralty Scale.		
	Ounces.	Grains of Carbon.	Grains of Nitrogen.	Ounces.	Grains of Carbon.	Grains of Nitrogen
Bread, in form of biscuit	84	15,372	1,907	140	25,620	3,178
Flour for puddings, etc.	32	5,408	243	9	1,521	68
Peas for soup	$5\frac{1}{3}$	856	80	8	1,288	120
Potatoes, dried ($1\frac{1}{3}=4$ of fresh)	6	294	6	8	393	8
Rice	8	1,408	28	4	704	14
Oatmeal	8	1,376	70	—	—	—
Total per week ...	—	24,714	2,334	—	29,525	3,388
Total per day ...	—	3,530	334	—	4,216	474

The Mercantile Marine also allowed 8 ounces of butter, 1 pound of molasses, and 1 pound of marmalade, per man per week, which materially increased the provision of carbon. The following is the bill of fare suggested by the committee; it is not, however, a very exemplary dietary:

SEAMAN'S BILL OF FARE.[8]

	Breakfast.	Dinner.	Supper.
Every day ...	Coffee, biscuit, butter, marmalade.	Biscuit and switchel.	Tea, biscuit, butter, marmalade.
Sunday ...	Dry hash, soft bread.	Sea-pie, plum-duff.	Cold beef and pickles.
Monday ...	Irish stew.	Pea soup, pork, and cavalances.	Dry hash.
Tuesday ...	Rice and molasses.	Salt beef, potatoes, plum-duff.	Cold meat and pickles.
Wednesday ...	Porridge and molasses.	Sea-pie.	Potato stew.
Thursday ...	Bread scowse.	Pea-soup, pork, and cavalances.	Cold pork and pickles.
Friday ...	Dry hash.	Preserved meat or salt fish, potatoes.	Fish.
Saturday ...	Porridge and molasses.	Salt beef, rice, and molasses.	Cold meat and pickles.

(*l*) Prison dietary (No. IV.), for men doing *hard labour* in English prisons[9]—Breakfast: Bread 8 ounces, and gruel or porridge 1 pint. Dinner: (*a*) Bread 6 ounces, potato 8 ounces, suet pudding 12 ounces; or (*b*) bread 8 ounces, potato 12 ounces, cooked meat, free from bone, 4 ounces; or (*c*) bread 8 ounces, potato 12 ounces, soup 1 pint. Supper: Bread 6 or 8 ounces, and gruel or porridge 1 pint.

The meat is beef; bread is made from whole meal; gruel is made with 2 ounces and porridge with 3 ounces of coarse oatmeal and salt, to each pint of water. The suet pudding contains $1\frac{1}{2}$ ounces mutton suet, 8 ounces of flour, and $6\frac{1}{2}$ ounces of water to each pound. The soup consists of, and contains in each pint, 4 ounces of meat, 4 ounces of split peas, 2 ounces of fresh vegetables, $1\frac{1}{2}$ ounces of onions, with pepper and salt. The entire daily ration contains: carbohydrate 572 grammes, proteid 116, and fat 37; or nitrogen 17 grammes (262 grains) and carbon 362 grammes (5,586 grains). These items are in excess of the generous allowances of Moleschott, and the carbon is in excess of that provided in the war ration for English soldiers; but there is a deficiency in the amount of fat, which cannot be supple-

mented by the extra amount of carbohydrate, and only to some extent by the proteid; the dietary could be improved by slightly reducing the amount of bread and potato, and adding margarine, dripping, or butter. Crauford Dunlop considers prison dietaries are, on the whole, well selected; he shows that the *ordinary* prisoner has fewer hours of labour and more hours of rest than the free labouring man, from which he concludes that the ordinary prisoner does not need more food than the free labourer. Using the standard of ordinary or moderate work, he considers that the energy value of the diet of the ordinary prisoner should be equivalent to 3,100 calories, and that the diet should contain proteid 120, fat 38, and carbohydrate not more than 550 grammes; for women he uses Atwater's figures: proteid 96, fat 30, carbohydrate 440 grammes, having an energy value equal to 2,480 calories, or enough for ordinary work.

When calculating the amount of food to be allowed in dietaries, we have to take into account the percentage composition of each article, reckoning the proteid, carbohydrate, and fat in each.

The amount of proteid in uncooked meat, fowl, fish, eggs, ham, horseflesh, etc., varies from 12 to 20 per cent., according to quality, digestibility, and mode of analysis; but they all contain about the same amount of *digestible* proteid, which for calculation may be reckoned as 15 per cent. The proteid in peas, beans, and lentils, is quite as much as in (more than in some) animal foods, but in making calculations they should be reckoned of the same value, weight for weight, because their proteid is not so easily digested. The proteid in fine white bread is 6, and in brown bread 8, per cent.; in wheat, barley, millet, and oats, the average is 12; in maize or Indian corn 10, rice 5, macaroni 9, arrowroot and corn-starch 0·8, potatoes 2, milk 4, cheese 31, butter 1, cabbage 1·8, carrots 1·6, sugar nil. per cent.

The amount of carbohydrate in wheat-flour is 70, oatmeal 63, barley-meal 71, rice 83, maize or Indian corn 64·5, arrowroot and corn-starch 83, rye-meal 67, millet 67, macaroni 76; in fine white bread 51, brown bread 49, biscuit 73; in potatoes 21, peas 53, cabbage 5·8, carrots 8·4, turnips 6, onions 10, kidney-beans 8, beet-root 10, milk 4, sugar 96, per cent.

The amount of fat in raw meat, game, or fish, may be reckoned as averaging 14 per cent.; in butter, dripping, margarine, and fat

meat, as 85 per cent.; in fat pork 49, fat bacon 73, smoked ham 36, poultry 3·8, white fish 3 per cent., bread or biscuit 1·5, rice only 0·8, oats and maize 5·5, millet 3·6, milk 3·7, cheese 28, cream 26 per cent.

Each gramme of proteid may be reckoned as yielding 4·1 calories, of carbohydrate 4·5, and of fat 9·1 calories, or units of heat.

The above considerations of the diet of man point to several conclusions. If a person, whose weight and nitrogenous equilibrium are maintained on a given diet, *consumes more proteid*—*e.g.*, lean meat—than is required, his body weight will gradually fall; for an excess of proteids leads to increase of metabolism. *If other foods are replaced by proteids*—*e.g.*, lean meat—the fat of the body will be consumed, owing to insufficiency of carbon in the food to produce heat and energy, and the body wastes in consequence, as in training for athletics and treatment for obesity. *If more fat and carbohydrate* are consumed, the body lays on flesh, and corpulency is favoured; in this way we have a *luxus consumption*, just as when a person eats too generously of all kinds of food, without any regard to the future condition of his body, only caring for the momentary satisfaction of the appetite derived from the pleasures of the table. **Proteids** are the most costly and luxurious foods, and their excessive consumption always provokes metabolic extravagance; but there is always a danger that metabolism will be defective or incomplete, and result in the accumulation of partially oxidized matters in the system, with various unpleasant consequences in the form of liver disease, gall-stones, gout, rheumatism, gravel, stone, obesity, Bright's, and other diseases.

Mixed diet is the best. Despite the fact that under certain conditions and in certain individuals health is maintained on a purely *vegetarian diet*, we are unable to get away from another fact—viz., that the average individual does best upon a diet of animal and vegetable foods combined; man is an omnivorous animal. 'The purely chemical statement of the amount of potential energy in a given kind of food is not a safe guide of the physiological value of the same.'[10] Thus, cheese stands very high in nutritive value, chemically speaking, but its digestibility depends mainly upon the individual, and, in consequence, it may have a very low physiological value. Similarly, the amount of

proteid in dried peas and beans is 23 to 25 per cent.—that is, more than in meat; but the physiological value of the same depends upon the functional activity of the individual liver and stomach, and perhaps is never quite as high as that of meat. Although 'the vegetable proteids appear to undergo the same changes in the alimentary canal as animal proteids, our knowledge of them is too imperfact to say that the body behaves exactly the same on a vegetarian as on a mixed diet.' An account is given by Foster of a man who lived for three years on fruit, bread, and oil exclusively, making a fairly typical vegetarian diet; his daily ration included proteid 54, fat 22, carbohydrate 557, and cellulose 16 grammes; but his excreta showed that he lost 41 per cent. of the proteid, 6 per cent. of the starch, and 30 per cent. of the fat, which passed out of his system undigested and unassimilated; he really only got from his food 32 grammes of proteid, 16 grammes of fat, and 540 grammes of carbohydrate; and a comparison with the normal or standard diets previously given will show that this was markedly deficient in fat and proteid, while the carbohydrate (chiefly starch) was in excess. A diet much richer in proteid can be obtained from the vegetable kingdom—*e.g.*, the average diet of a Japanese peasant is estimated to contain proteid 102, fat 17, and carbohydrate 578 grammes; and a Roumanian peasant, living on beans and maize, received proteid 182, fat 93, carbohydrate 968 grammes per diem, the latter being similar to that of many Italian peasants who live on beans, maize, and oil. The use of ages has accustomed the natives of certain countries to eat large quantities of millet, rice, and pulses; but a person unaccustomed to the diet would be unable to digest it—the mere bulk would be too much for him. Indeed, the real nutritive or physiological value of such a diet would be very much less than the chemical or apparent one, as was proved by analysis of the excreta of the English vegetarian quoted above. An analysis of the *modified* vegetarian diet, in which eggs and milk figured prominently, of a person who maintained fairly good health and nitrogenous equilibrium showed it to contain proteid 74, fat 58, carbohydrate 490 grammes; unless, therefore, the food consumed be in large amount, the proteid element of a vegetarian diet falls below the normal, or that which is considered by all authorities as essential

to maintain the wear and tear of the human machinery (see 'Vegetarianism'). We must conclude, therefore, that for civilized man a mixed diet is the best, as providing a greater proportion of proteid material, and exacting less work from the digestive and eliminatory organs. It is true that habit is an important factor: that civilized man has a large control over his food and clothing, and other conditions under which he exists; his aim ought, therefore, to be to co-ordinate the conditions of his life to that which is ideally the best. A celebrated medical man formulated the rule of reply when asked by his patient if he might have particular articles of food: 'Ask if he likes it, and if it agrees with him; if it does, there is no intelligible reason why he should not have it.' But this does not always follow, for articles which apparently agree with persons may not be advantageous to them—*e.g.*, sugar and starch for diabetics. Pythagoras left us the following useful maxim: 'Find out that course in life which is best, and habit will make it delightful.'

Size and Weight.—It would appear at first sight that the total daily amount of food ought to vary with the size and weight of the individual; and in discussions on nutrition generally, statements are made per kilogramme of body weight. In a broad sense, a small man needs less food than a large one; but Foster[11] says: 'The smaller organism, having a *relatively* larger surface of body, carries on a more rapid metabolism, and consequently needs a relatively larger proportion of food'—*i.e.*, more food per kilogramme of body weight; but the influence of size in this respect is far less than the inborn character of the organism, or what may be called the personal equation of metabolism. The metabolism of a woman is less than that of a man, which is a more important cause of the scantier consumption of food by women than mere size and weight. Thus, an active man and his wife, both of the same age and nearly the same weight, lived for some time on the same food, and their nutritive equilibrium was maintained when the food they daily consumed contained the following proportions, in which the most remarkable difference is in the smaller consumption of meat by the woman:

Weight and nitrogen equilibrium maintained upon—

	Proteid.	Fat.	Carbohydrate.
The man	100	70	400 grammes.
The woman	60	67	340 ,,

Age.—In spite of scientific investigations as to the bodily requirements of persons who have reached adult life, and of the amount of food they should consume, we are bound to admit that the personal equation may upset the calculation, and that scientific figures can only be given for averages, unless similar investigations are made upon each individual. The general rule must guide us, but the personal equation may enforce a modification of it in practice. With regard to young adults, the skeleton or framework may cease to grow after seventeen or eighteen years of age, but certain organs do not reach their full development before twenty-five, up to which period it is always prudent to consider the young adult as having not quite completed his physical development, and consequently to feed him abundantly in proportion, as more or less of the food has to go to the manufacture of flesh, blood, and bone, or only to be consumed in the production of heat and energy and to maintain bodily wear and tear. Young females attain complete development a little earlier in life than males. In both cases, after the period of growth and development is completed, the amount of food required is not quite the same as during the period of growth. It should, however, be clearly understood that throughout the active period of life the healthy adult should have sufficient food to meet the daily needs of the organism, to supply force and heat, to replace tissues worn out, to keep the organs in good repair and the whole body in sound health. Deficiency of proteid, being the most costly form of food, is that which is most common; and **proteid-starvation** is not uncommon amongst many poor but respectable people who have to live for long upon a diet in which 'tea and bread-and-butter' figure largely, but in which the proteid is markedly deficient. The general principles already dilated upon should guide us in individual cases; and where the cost of animal proteid (meat, fish, milk) is beyond the power of purchase, the freer use of the vegetable proteids in haricot beans, lentils, and dried peas, is highly recommended.

Variety of food is necessary, for monotony even of the best kinds of food leads to satiety, loss of appetite, loathing of food, and consequent ill-health. Vegetables and fruit are absolutely necessary to the dwellers in towns; but raw fruit and vegetables are not so easily digested as the same kinds are when cooked;

hence, while recommending the free use of oranges, lemons, bananas, tomatoes, grapes, strawberries, etc., it should be remembered that apples, many kinds of pears, gooseberries, and other fruit, are best when cooked before they are eaten.

Overfeeding is to be guarded against. It has been said that more people die from excessive eating than from excessive drinking. Too much food is habitually consumed by many people, especially those who have easy access to it. The effects of occasional overfeeding may be relieved by **a bilious attack.** If persons in sound health eat more than they require, the surplus must be disposed of in some way ; a certain amount may be stored up in the body as glycogen and fat, but very often an 'undesirable balance remains against the feeder,' which exerts an evil influence in one way or another by causing headache, lethargy, diseases of the liver, uric acid accumulations, gout, rheumatism, gravel, or diseases of the bloodvessels. If the individual is very active, more food can be disposed of than if he is inactive and leads a luxurious life or has a sedentary occupation. But if he spend much of his time indoors, in warm, close, or ill-ventilated rooms, the balance tells against him very disagreeably; it may be packed away in the subcutaneous tissues or around the internal organs, and the individual then becomes obese, corpulent, and heavy. Other persons, however, do not seem to have the power of storing up food in the form of fat, however rich and abundant it may be, and however inactive and luxurious their habits ; in such instances it causes the troubles named above. Therefore an excess of food in adult life encourages or causes the diseases to which people are liable in late-middle and advanced age. In youth and early adult life excess of food may be disposed of by more ready digestion and assimilation, by greater metabolic activity, and by their greater capacity for physical exercise, whereby such excess may be used up and eliminated. It is advisable that adults should continue out-of-door exercises and games as far and as long as possible to keep their digestion good, their liver in order, and their body slim and trim, for the assimilating and eliminating organs are much influenced by activity or otherwise ; and this may be imitated to some extent by the use of Turkish or Russian baths and purgative waters, which are strongly recommended for such people.[12]

THE TIME AND NUMBER OF MEALS.

An ordinary full meal requires, on an average, four and a half or five hours for its complete digestion, some foods occupying a longer, others a shorter time. Children, by virtue of their more rapid digestion, greater metabolic activity, and power of assimilation, need more frequent meals than adults; growing active youths are very similar in this respect; and adults whose occupation keeps them much out of doors and physically active digest their food more rapidly and completely than middle-aged persons or those whose occupation is of a sedentary character. By eating at too short intervals—that is, by taking a fresh meal before the complete digestion of the former one—many cases of indigestion and gastric catarrh arise.

As a general rule, active persons who lead a regular life may eat their *breakfast* as soon as they arise; indeed, any amount of exertion *before taking food* is apt to lead to languor and a feeling of exhaustion, and ultimately to dyspepsia; the delicate, feeble, and underfed, are also liable to take harm from cold, infection, or any other insanitary condition to which they may be exposed, which is an important reason why they should breakfast before going out. But obese, overfed, and certain dyspeptic patients, may require a short walk, a little exercise in the garden or on horseback, before taking a meal. On the Continent a very light breakfast is taken, consisting of a cup of coffee and a little bread-and-butter, dry toast, or similar light article; and custom or habit helps them to tide over the interval between this and the mid-day breakfast or *déjeuner à la fourchette*. But in England and Germany a more substantial meal at 8 or 9 a.m. is the custom, and agrees with the majority of people who are occupied during the forenoon on business; but there are many people who, by idiosyncrasy or habit, or owing to gastric ailments, are unable to take more than a very light breakfast, and appear to do very well on that for a few hours. The former may begin the meal with hominy, porridge, or fish, and follow this with an egg or a little bacon or ham, ham and tongue, or cold poultry, accompanied by bread-and-butter, dry toast, marmalade or preserved fruit, and tea, coffee, or cocoa. The latter will probably find a cup of tea and a slice of dry toast and butter, or the very smallest particle of fish or bacon, all they can consume at this time; and they

would, perhaps, not feel so well or be able to perform their duties so satisfactorily if they ate more. They are, however, more rapidly exhausted than the former, and usually require a glass of milk and a biscuit or similar light article in the middle of the morning. People who dine late, 8 or 9 p.m., and make a substantial meal then, ought to have a very light breakfast.

The time and substance of *the mid-day meal* should be varied with the breakfast. A very light breakfast should be followed by an early and ample meal at noon; but a substantial breakfast should not be followed by another meal until 1.30 or 2 p.m., and it should be light in proportion as the breakfast was substantial or the last meal will be heavy. If, then, the breakfast was a substantial one, the *lunch* may consist of a little soup or fish, followed by a chop, a little cold poultry or game, with bread or potato; but this should be the extent of it. If, on the other hand, the breakfast was a light one, and the mid-day meal is *dinner*, it may consist of soup or fish, followed by hot meat from a joint or game or poultry, with potatoes, vegetables and bread, light pudding or cooked fruit and custard, and a little cheese and butter. A little cheese after a hearty meal is a stimulant to digestion. Mid-day dinner is not ideally the best for the man whose work is chiefly mental and of a sedentary character.

The last meal, called dinner or supper according to custom, and the extent of it, has now to be considered. If this meal is 'dinner,' it should be taken about 7 or 8 o'clock, or at least four hours before going to bed, and will have been preceded by the light lunch referred to. It usually consists of soup or fish or both, an entrée, hot meat from a joint, game or poultry, with fresh vegetables, potatoes and salad, sweets, light pudding or cooked fruit, cheese and biscuit, and dessert. 'Supper' is the last meal in the very large proportion of houses where dinner is a substantial repast taken at mid-day; it must be a light meal, taken at least two hours before bedtime, and may consist of a little light fish or porridge, cold joint or poultry, or ham and tongue, *with salad*, and a little bread, butter, and cheese.

'Tea' is a difficult meal to regulate; it varies according to habit, custom, and usages of localities; nevertheless, it ought to be regulated by physiological necessity. In the first place, a cup or two of tea about 4.30 or 5 o'clock agrees either with an early

or late dinner; the liquid is then favourable to digestion, it assists in completing the digestion of the mid-day meal, and it rouses mental and physical activity and supports the body until the time arrives for the later meal, which is essential to those who have lunched lightly. It is, however, physiologically wrong to make a meal at this time; it should consist of tea alone, or with a slice or two of bread-and-butter or a little cake, nothing else. Exception is to be made in the case of children, growing boys and girls, and perhaps young adults, whose digestion is very rapid and whose supper is light; four meals a day is the proper thing for them, but they have been previously considered. It is wrong, however, for adults and those in middle life to consume much at this time; indeed, the custom of 'high tea' at 5 or 6 o'clock is responsible for much indigestion, gastric catarrh, and liver trouble. It is wrong, in the first place, not to allow a rest to the stomach, or to put more food into it before the last meal is quite digested; it is, therefore, contrary to physiological rules to consume meat, fish, ham, pastry, and similar things, at this time.

The Germans arrange their meals at similar times to the English, but they almost universally dine at 12.30 noon, and take their supper at 7.30 or 8 p.m. Less food is eaten in France than in England; a cup of *café au lait* or chocolate with dry toast or a biscuit is taken in the bedroom on getting up, and this does not delay their professional work, which begins at 8 or 8.30 a.m. Their first formal meal is the *déjeuner à la fourchette* at about 11.30 a.m., which makes an agreeable change in the day's routine; they consume it slowly, and rest for some time after it while they sip a cup of coffee and smoke. The next meal is at 6 or 7 in the evening, and consists of soup, fish, entrées, and several dishes containing meat or game, with potatoes, vegetables, salads, sweets, and dessert. This is a substantial meal, and being taken at the end of the day's work, and a long time before going to bed, they give more time to it, and are less oppressed by it than they would be by eating a meal hurriedly and at once rushing back to business or intellectual work. Moreover, greater attention is paid to the art and practice of cooking, to the care of, preparation, and manner of presenting the food, which is conducive to the pleasure of consumption, and increases the nutrition and stimulation which may be derived from it.

FOOD IN RELATION TO OCCUPATION.

(*a*) **Bodily Labour.**—Food supplies heat and energy, but the energy expended in work done is not altogether separate from that which is set free as heat, for an increase of work involves an increase of heat. A man doing a hard day's muscular or physical work needs a larger income of energy, therefore, of food than an idle man or a man who is resting. Given *a normal diet*, an increase of work does not necessarily require an increase of proteid or animal food, for the energy for muscular work does not come from proteid metabolism or consumption of the muscles, as was once thought. In fact, it is carbon metabolism which is increased by muscular work; therefore *extra food for extra work should consist of carbohydrate* material in the form of bread, puddings, sugar, and other sweets. But the power of doing work does not depend on the muscles alone, but on the heart, lungs, and nervous system. Fatigue is more a nervous than a muscular condition; and distinctly muscular fatigue is partly due to the accumulation of waste materials in the muscles as well as the consumption of available energy. It is possible, therefore, that what is needed by a man doing hard physical labour is a slight increase of the total amount of food on the lines of the normal diet, but with a leaning towards carbohydrate. The following is a fair average diet for a man at work—Breakfast: Porridge, consisting of 2 ounces of oatmeal or cornmeal and $\frac{1}{2}$ pint of milk, or 4 ounces of cooked beef, mutton, ham, or bacon, or two eggs, together with 6 ounces of bread, $\frac{3}{4}$ ounce of butter, 1 pint of tea or coffee, with $\frac{3}{4}$ ounce of sugar, and milk or cream. Dinner: Soup, 6 ounces; cooked meat, game, or fish, 4 to 6 ounces; potatoes, 8 ounces; cooked vegetables, 4 ounces; bread, 3 or 4 ounces; rice or other pudding, 6 ounces; cheese, $\frac{1}{2}$ ounce; ale or water, $\frac{1}{2}$ pint. Tea: Tea, $\frac{3}{4}$ pint; sugar, $\frac{3}{4}$ ounce; milk, 2 ounces; bread, 4 ounces; butter, $\frac{3}{4}$ ounce. Supper: Cooked meat or fish, 3 ounces; or two eggs, or porridge, consisting of 2 ounces of oatmeal or hominy and $\frac{1}{2}$ pint of milk; with bread, 3 or 4 ounces; butter or cheese, $\frac{3}{4}$ ounce; water, ale, or cocoa, $\frac{1}{2}$ pint. The total amount of this diet is equivalent to $12\frac{1}{2}$ ounces of meat and 2 pounds of bread, and is enough for a man doing full work. The items consist of the ordinary and customary forms of food, which, however, can be infinitely varied.

When calculating the quantity of food required for a number of people, it is usual to reckon one-tenth less for a woman than for a man in the same circumstances; for a boy of fifteen as much as for a woman; and for a youth of eighteen as much as for a grown man when performing similar work. The dietaries given on pp. 76-84 will be a sufficient indication of the amount of food required under various circumstances.

There are certain circumstances in which it is impossible to obtain a regular supply of *fresh* food for workmen—*e.g.*, seamen, and those occupied in certain expeditions on land. In such cases great care must be taken that the food does not become too monotonous, as a regular bill of fare is liable to do. Fresh meat and vegetables must be obtained when possible, and salt meat should be varied with preserved or tinned meat. Potatoes ought always to be allowed, and green vegetables should be as abundant as possible. Preserved meat and vegetables can be obtained in perfection, but fresh ones are more antiscorbutic, and should always be served out when possible. Lime-juice is a good preventive of scurvy, and when it cannot be had, vinegar should be allowed with salted meat. Pickles are also antiscorbutic, and should be freely used when fresh vegetables cannot be had. Butter, suet, raisins, rice, sago, oatmeal, marmalade, and molasses, are amongst the usual supplies. Raisins and suet are good in boiled pudding—'plum-duff'; oatmeal or boiled rice and molasses are good for breakfast, and marmalade for dinner. Bread should be baked fresh as long as possible; but the monotony of salt beef or pork, tinned meat, fish, pea soup, rice or porridge, plum-duff, dry biscuit, and tea or coffee, is by no means appetizing, especially in the tropics, and is probably one reason why the men drink so freely of alcoholic beverages.

The Diet of Athletes.—The object of training for athletic exercises is to bring about the highest degree of strength, activity, and endurance, of which the body is capable. By the special exercises and dietary a loss of weight is usually induced, owing to the consumption of the fat of the body; if it is carried too far he is *over-trained*, and thereby weakened, instead of his muscular and nervous apparatus being invigorated. If he is still encumbered by useless fat he is *under-trained*, and an endeavour is made to strike the happy medium. The food consists largely

of mutton chops, under-done beefsteaks, broiled or grilled, stale bread or toast, any kind of green vegetable, and a small amount of potato. The transition from ordinary diet to that of the trainer should be made gradually, and not suddenly. He must *avoid* all puddings, pastry, sweets, sauces, pickles, and spirits; he *may drink* tea, coffee, cocoa, a little beer or light wine, also toast-water, barley-water, black-currant tea, and similar drinks. Usually three meals a day are taken. The diet adopted by King was as follows[13]—Breakfast: Two mutton chops, with dry toast, crust, or stale bread, without butter, one cup of tea without sugar. Dinner: $1\frac{1}{4}$ pounds of lean beef or mutton, with toast or stale bread, a *little* potato, some greens, and $\frac{1}{2}$ pint of old ale. Tea: An egg, with dry toast, and one cup of tea. Supper: $\frac{1}{2}$ pint of gruel or old ale. When 'tea' is not a meal, the supper may consist of cold meat, bread, lettuce, watercress, and 1 pint of beer.

This diet is similar to that adopted by the late Mr. Banting when treating people for corpulency. It contains an excess of proteid, and a corresponding deficiency of carbohydrate and fat, with the consequence that superfluous fat and water are got rid of and weight diminishes, while at the same time an endeavour is made to effect the fullest development of the muscles and nerves by the manner of feeding and exercise. The latter consists of walking up to twenty miles a day, and special exercises for certain groups of muscles in the way of rowing, boxing, cricket, or other form of sport in which it is desired to excel.

(*b*) **Mental Work.**—The same principles which guide us in adjusting the food of the labourer, mechanic, soldier, sailor, and all who do physical work, should be applied in fixing that of the clerk, accountant, architect, lawyer, clergyman, journalist, banker, statesman, or other individual, whose work is chiefly of an intellectual or mental character. The actual expenditure in doing mental work is relatively small, but its influence upon the entire organism is very great. The close and intricate connection of the brain and nervous system with the functions of digestion, assimilation, and metabolism generally, is shown by the readiness with which the stomach and liver become deranged by such work, and especially when combined with worry and anxiety.

If any special diet is required by brain-workers, *it bears no particular relation to the brain* of those whose occupation is chiefly of an intellectual or mental character, but it must have a special reference to *the stomach*, and should be directed towards lightening the labours of that organ, and of keeping the liver and other eliminating organs in healthy action.

The normal diet should again be our guide; but those whose work is chiefly mental and largely sedentary do not need quite so much food as people whose pursuits take them more in the open air or involve much physical exercise. It has already been observed that a man doing ordinary *physical* work requires more food, both proteid and carbohydrate, than the same man at rest; and likewise a man doing less physical work, or whose occupation is chiefly mental and of a sedentary character, requires somewhat less food than those doing more physical work, but the proportions of proteid, carbohydrate, and fat, should remain the same as in the normal diet = proteid, 100; fat, 100; carbohydrate, 240 grammes. *But they should live upon lighter and more easily digested food* than is absolutely necessary to the physical labourer or the growing individual.

The food should consist of soup or broth; fish of the lighter kinds (whiting, sole, plaice, turbot, brill, flounder, cod, haddock, chad, bass, skate, oysters); lamb, mutton, or tender beef, taking care to remove skin and gristle; fowl, pheasant, and rabbit are more suitable than venison, hare, or other game; eggs, bacon, fat ham, tongue, tripe, sweetbread; milk, cream, cream-cheese, new milk-cheese, butter; stale bread, dry toast, biscuits, oatmeal, hominy, blanc-mange, rice, sago, tapioca, and other milk puddings, or custard, junket, egg-snow, jelly; potatoes, sweet potatoes, artichokes, asparagus, French beans, green peas, vegetable marrow, pumpkin, spinach, cauliflower, and small quantities of Brussels sprouts, cabbage, savoy, or kale; but turnips, carrots, parsnips, and fibrous cabbages and vegetables, should only be taken in the form of purée or consommée. Raw fruit which is ripe and sound may be eaten in moderation, especially grapes, oranges, bananas, tomatoes, strawberries, raspberries, nectarines, apricots, greengages, and pears; and *cooked* apples, gooseberries, currants, plums, or rhubarb, may be eaten to a reasonable extent.

Things to be avoided.—The importance of keeping in order the stomach and liver of those who do mental work has been already mentioned, and it cannot be too much insisted upon. They should, therefore, avoid rich food, rich soups or sauces, 'force-meat,' veal, pork, duck, goose, sausage, fried eggs, fried fish, and other articles fried in fat; liver, kidneys, brain; pickled or salted meat, venison, hare, and 'high' game, and the skin and gristle of beef, mutton, and all other animal food. Also much pastry, rich cakes, hot buttered toast, crumpets, muffins, pancakes, new bread, boiled puddings, nuts, and very much uncooked fruit, vegetables, or salads, and especially heavy or fibrous vegetables, unless they are reduced to a purée, because the fibrous portions are indigestible, and they are very flatulent (see also 'Indigestion' and 'Gastric Catarrh').

Sir W. Roberts divided foods into two classes: (*a*) Those which subserve the needs of general nutrition—*e.g.*, meat, fish, eggs, milk, dairy products, bread, cereals, legumes, vegetables, and fruit; (*b*) tea, coffee, cocoa, and to some extent alcohol and tobacco. Meat belongs to both classes, for it possesses certain stimulating properties, which distinguish it from vegetables and dairy produce. Tea, coffee, alcohol, and tobacco, are sometimes branded as luxuries, but Roberts says 'they are not inappropriately termed *brain foods*, and must be regarded as a very important part of the equipment for the struggle for that higher and better existence among civilized men, which is almost exclusively a brain struggle.' The importance of fat in the food of such people is seen to be very great, when we consider that the muscles only contain 3 per cent., but the brain has 8 and the nerves 22 per cent. of fat; and we at once perceive the high value of butter and cream or bacon for breakfast, and other forms of fat, in the food of men who are devoted to all kinds of mental or intellectual work, if their nervous system is to maintain the ability of properly performing its varied functions. Fish is chiefly of value to them because it is lighter and more easily digested than butcher's meat, does not contain quite so much nitrogen, and therefore throws less work upon the liver and eliminating organs, for which reasons it is recommended as a substitute for meat to some extent, but not because it has any special claim to be regarded as a brain food. The importance of

fresh vegetables and fruit of a digestible character, especially to those who live in towns, cannot be overlooked.

The best order of meals is breakfast, lunch, a cup of tea at five, and dinner at seven or eight in the evening. The man whose occupation is sedentary, and whose work is chiefly mental or intellectual, will do well not to eat a heavy meal in the middle of the day if he has to go on with his work at that time, because he may be incapacitated by it for work for an hour or two; indeed, it often causes languor, dulness, drowsiness, or heaviness, and should be followed by mental and physical rest. Exercise or brain-work during the digestion of a full meal acts deleteriously by withdrawing from the stomach to the brain or muscles the blood which is required for the secretion of gastric juice, by which means indigestion is favoured or actually caused.

Excess of food is bad for everybody, but especially for brain-workers. If they consume an excess of animal food, they will become languid, oppressed, subject to headache, indigestion, disease of the liver, and many ailments associated with the production and elimination of uric acid and its allies of the purin class. They ought, therefore, to have porridge, fish, eggs or fat bacon, for breakfast, and butcher's meat only once a day, with plenty of milk puddings, the latter being admirably suited to these people as a supply of both proteid and carbohydrate. If they take an excess of carbohydrate in the form of bread, oatmeal, arrowroot, and other starchy foods, they will probably suffer from acidity of the stomach, heartburn, flatulence, palpitation, burning of the hands and feet, and other discomforts. They should not eat new bread, hot cakes, hot buttered toast, crumpets, muffins, pancakes, boiled fruit or suet puddings, because they often cause headache, dulness, heaviness, and mental depression, which act as a clog upon the mental functions. In like manner they should avoid cheese, except about a cubic inch at the end of dinner, and heavy vegetables like turnips, swedes, carrots, parsnips, very much cabbage, or raw fruit and nuts and other hard substances, which cannot be easily digested by those who do not take much active exercise. Radishes, cucumber, raw onions, celery, and the like, contain much cellulose, which cannot be digested except by bacteria in the large bowel, and, like cabbage, turnip, and carrots, are very flatulent as well as difficult of digestion, and

should therefore be eaten in great moderation by all persons of sedentary occupation. Beans and peas require a stronger stomach and a longer time for digestion than animal food ; they generate sulphuretted hydrogen and other gases in the bowels, and, like other heavy foods, make the brain dull and inactive, wherefore a meal of 'pork and beans' would be wrong for this class of persons. 'Made dishes,' highly-spiced foods, articles cooked in butter or fat, and other 'rich' foods, check the secretion of the gastric glands, cause indigestion and liver trouble, and in turn interfere with the nutrition and activity of the brain.

Drink may consist of plain water, tea, coffee, cocoa, and a moderate amount of alcohol, in the form of light dinner ale, lager beer, hock, moselle, burgundy, or other light wine, or a little well-diluted spirit. The dictum of the governors of large bodies of men is that all work is better done without alcohol. Necessity or individual idiosyncrasy may require it, but it should be remembered that if the effect on the brain is to make it active and quick, it is only a temporary effect, while the after-effect upon the body may be such as to react upon the brain and nerves. Anyhow, it can only be taken in moderation if the head is to remain clear, the stomach free from catarrh, and the liver in good order, which are points of importance to the men whose work depends upon clear-headedness, mental activity, and a general feeling of well-being. The question of drinking milk as a beverage remains to be considered. This is a highly-nutritious fluid, which contains a good percentage of proteid in such a condition that it becomes solid when it mingles with the gastric juice in the stomach. If, therefore, it is drunk with the lunch or dinner, the consumer may unwittingly take a larger amount of proteid material than he requires; and, because it adds to the solidity of the meal, it lays a strain upon the stomach to digest it, and it is apt to be followed by headache, dulness, and drowsiness, just as when too much meat is eaten. It is therefore erroneous for men and women who take little active exercise, or who have much mental work to perform, to drink milk with a meal in which animal food forms a prominent part.

DIET IN RELATION TO CLIMATE.

The chief difference in the food consumed by persons in countries out of the temperate zones attaches to the temperature of the climate. When the body is exposed to a low temperature the general metabolism of the person is increased, from which we infer that more food is necessary *in cold climates* than in temperate ones. The increase of metabolism consists in the greater discharge of carbonic acid gas, which, therefore, must be met by the consumption of more fat and carbohydrate than the same person would take in a temperate climate, fat supplying twice as much heat as carbohydrate in proportion to its weight, and carbohydrate requiring more labour on the part of the digestive organs to convert it into easily oxidizable material. An increase of the proportion of animal food eaten by those who live in cold climates is therefore a scientific procedure. In cold northerly climates vegetation is scarce, but animals which provide the natives with fat are abundant, and the necessity for supplying the body with a large amount of combustible substance in the form of fat and other animal food accords with the love of such material by the inhabitants of arctic climates, which may be taken as a safe guide in this matter.

When anybody is exposed to the greater heat of *hot climates*, the general metabolism of the body is somewhat decreased, in spite of which the temperature of the body is maintained at about the normal degree, even when the temperature of the surrounding air is higher than that of the body. This, however, is not so much the result of diminished production of heat, but because a greater amount of heat is lost from the surface of the body by perspiration, by radiation, convection, conduction, and evaporation ; from which it is concluded that it is not necessary to take less food in hot climates than temperate ones, but that there should be a little increase of carbohydrate foods to supply the heat which is lost from the skin, and for the greater evaporation of perspiration.[2]

In tropical and other climates where they have prolonged hot seasons, as in Southern Europe, South America, India, Africa, the West Indies, the natives live much on fruit and vegetables where these can be obtained, and less on animal food than those

who dwell in colder regions of the earth. But it has been already observed in this chapter that unless such food be consumed in large amount the proteid element will fall below the normal quantity, or that which is considered by all authorities as essential to maintain the wear and tear of the human machinery. Men going to live in warm climates must consume on the whole *a normal diet*, containing the same daily proportion of proteid, carbohydrate, and hydrocarbon as elsewhere, and the quantity consumed should be proportionate to the mechanical work to be done—that is, there must be a balance between the income and expenditure of the body. The only change necessary is a slight increase in the amount of carbohydrate consumed, with the special view of furthering perspiration.

At first sight it would appear beneficial to the white man, when living in foreign climates, to restrict the consumption of animal food and live chiefly on vegetables and fruit, according to native custom. But medical testimony as well as physiological fact is opposed to this. A strictly vegetarian diet, even when it contains as much proteid as ordinary food, is physiologically inferior to a mixed diet, or that in which animal food occupies its proper place. Long centuries of usage has accustomed the natives to eat large quantities of manioc, rice, millet, the pulses, and other vegetables; but a person unaccustomed to such a diet would be unable to digest it at first, and the mere bulk would be too much for him; besides, the cayenne pepper and other condiments which the natives consume would set up gastric catarrh and congestion of the liver in a short time. However, the tendency to scurvy in all tropical countries necessitates the consumption of plenty of fruit and green vegetables.

A few particulars may now be given. **Meat** should only be eaten twice a day and in moderation. It should always be well and carefully cooked. Heavy luncheons should be avoided, and the dinner is best taken after the work of the day is over. The digestive organs are more easily upset in the tropics than in the temperate regions, and cannot so well bear the strain of over-eating. Beef, mutton, pork, goat (kid), venison, fowls, and fish, are usually obtainable. In some places antelope (of which there are many varieties), ducks, pigeons, guinea-fowls, pea-fowls, partridges, bustards, and other animals useful for food, make a

pleasant variety. Milk is obtainable from cows, goats, and asses. The latter is very suitable for infants as a substitute for mother's milk, and goats can easily be moved from place to place as necessity requires. **Tinned foods**, such as meat and fish, should be avoided if possible. If compelled to use them, the whole tinful should be consumed at one meal; nothing which is left ought to be eaten afterwards, because such foods are liable to speedy degeneration from bacterial growth, and may cause ptomaine-poisoning. The flesh of goat, deer, antelope, native pig, birds, and even fish, is infinitely better and safer than any kind of tinned food; the eggs of fowls and other birds, the flesh of turtle, clam, and other molluscs, may also be had in many places. Besides which, there are sources of proteid supply in the form of ground-nuts, oatmeal, bean flour, pea flour, banana flour, which, being eaten with milk in porridge or in soup, form a most nutritious food.

The **carbohydrate** supply is derived from bread, which should be made fresh as long as possible; biscuits; also rice and ground-rice in the form of puddings, boiled rice, curry; oatmeal; maize or corn meal, which may be cooked like oatmeal and eaten with milk; banana flour in form of porridge or thin gruel; ground-nuts; sago, tapioca, arrowroot, semolina, vermicelli; sugar, jam, marmalade, honey.

Vegetables.—Potatoes should be grown by every settler; they will grow almost anywhere, and are an important food, not only as a source of carbohydrate for supplying heat and energy, but because of their antiscorbutic properties, so much needed by residents in the tropics. Sweet potatoes are grown in many places, and make an excellent substitute; cassava in its season, boiled in several waters and then fried, resembles potatoes; green indian corn or maize (**mealies**), when boiled in milk or roasted in ashes, is very good; yams and bread-fruit are also excellent; tomatoes grow almost anywhere; green bananas or plantains may be boiled or roasted in ashes, and form an excellent vegetable; green peas and kidney beans, pumpkins and vegetable marrow, even cabbage and cauliflower, are obtainable, or can be grown by the settler; the fruit of the papaw is an excellent vegetable, and when boiled resembles vegetable marrow. Fruit may be eaten abundantly when fully ripe—but it is better eaten during the day than at night—as oranges, lemons, limes, melons,

papaws, bread-fruit, bananas, plantains, mangoes, guavas, olives, figs, dates, apricots and other plums, and pineapple (juice only should be taken freely). Dried fruits, as figs, dates, prunes, apricots, apples, and tinned fruit, are very useful whenever the fresh articles cannot be obtained.[14]

Beverages.—Tea, coffee, and cocoa are the best; their various substitutes, as kat, Caffre tea, Dorn-thé, goora-nut, maté, guarana, may be had and used in the districts where they are customary articles. Lime juice makes a valuable drink, but fresh-made lemon-water is much better; raspberry vinegar and water, black-currant water, barley-water, rice-water, oatmeal-water, banana wine, toddy, whey, tamarind-whey, koumiss, are all useful drinks in various conditions of health and sickness. It should be remembered that thirst, and relieving it by frequent potations, is a matter of habit and education, *and can be largely controlled.* Frequently drinking large quantities of liquid, especially when overheated or fatigued by a journey, is injurious; nevertheless, we have to bear in mind the excessive perspiration induced by the heat of the climate. Drinking a large quantity of water from a running stream while excessively hot is capable of causing the person to become insensible; and drinking much milk alone while in the same over-heated condition may cause acute gastritis. The use of alcohol in the tropics is a matter requiring grave consideration; it is a vexed question, and has been very hotly debated. It is admitted on all hands that, when suitable food is provided, men are better in health without it, and can perform their duties more satisfactorily. Mohammedanism, the religion of millions who dwell in hot climates, is against its use, and backs up scientific facts. Spirits, especially, are very injurious, unless freely diluted with water; wine and beer should only be drunk in moderation—about half-pint of light red wine or one pint of beer a day is considered a very fair allowance, but even that is better replaced by tea and coffee, which are at all times the best stimulants.

In expeditions in foreign countries, campaigns on land or long sea voyages, where there may possibly be a shortage of *fresh* food, a large amount of dried, salted, and even concentrated food, is usually provided. Concentrated food consists of water-free material, which occupies a very much smaller space and is less heavy than ordinary food. It is found that in making short

expeditions—say, four or eight days—each man's daily ration may be reduced to about 12 ounces of *water-free* material; and, provided he is well fed beforehand, life and vigour may be preserved on that amount; but he will constantly lose weight, and time and food must afterwards be allowed to make up for the consumption of his own flesh caused by the reduction of supply.

During all foreign expeditions, whether by land or water, it is very important that *fresh* food should be given as long as possible, for there is something in the very newness or freshness which is important to the health and vigour of the consumer; thus fresh meat is better than preserved meat, bread better than biscuit, fresh fruit and vegetables better than dried fruit and vegetables, and new milk is better than condensed. Therefore, bread should be baked as long as possible; when this is no longer possible it is replaced by biscuit; and when biscuit is issued for more than a week at a time it is advisable to add an extra allowance of flour or rice for making pudding or oatmeal for porridge. When fresh meat is no longer to be had, reliance has to be placed on foreign meat (American or Australian), salted beef or pork, tinned meat, dried meat (biltong), pemmican, or meat biscuits; and it is recommended that vinegar should be taken with salted meat when it has to be consumed for more than a few days. Peas, beans, lentils, durra or millet, and ground-nuts, will replace the meat; and pea and beef sausage, pea or bean soup, haricot beans, or other similar preparation, may be used when fresh meat is scarce or absent. When fresh vegetables or potatoes are no longer obtainable, and preserved ones are being used, lime juice, or, probably, fresh lemons, must be consumed freely to prevent scurvy and other ill-effects which accrue from their long absence. The governors, or those in charge of all expeditions into hot climates, aver that alcohol is better done without; that the important work of such expeditions is always better done by the teetotallers or those who are extremely abstemious; that alcohol is the very rock on which the men are likely to become wrecked; that excessive drinking, combined with the atmospheric conditions, lowers their vitality and renders them a ready prey to disease; that spirits ought never to be allowed, and if any alcohol is deemed necessary it should consist of light wine or beer.

FOOD IN MIDDLE LIFE AND OLD AGE.

Age is ever increasing upon us, and if we desire to have the elasticity of youth in middle life, and the vigour of middle life in old age, we must practise abstinence, or at least temperance, in many things while we are still young.

It may be stated with certainty that, if we wish to live to a good old age, we must begin to lay in a store of vitality at a comparatively early period. There can be no fixed rules for this, and much depends upon one's personal common-sense and individual peculiarity. There is no doubt a sound constitution and careful living are among the best means of attaining length of life; and in nothing, perhaps, does heredity make its influence more felt than in this particular. There is no secret means of attaining longevity; the people who have lived to a great age have nothing to reveal; their modes of life, though diverse, have run upon ordinary lines. According to the *British Medical Journal*, Moltke, the Russian General, in his ninetieth year, said he had maintained health and activity by great moderation in all things and by regular out-of-door exercise; Crispi said regularity and abstinence are the secrets of a long life; the Hon. Neal Dow of Maine laid stress on the avoidance of fretting, disturbance of the digestive organs, and protection from sudden cold; Cornari was extremely moderate in his eating and drinking: he took everything which agreed with him and nothing which did not; and Abraham Lincoln's advice was: 'Don't worry, eat three square meals a day, say your prayers, think of your wife, be courteous to your creditors, steer clear of biliousness, go slow and easy.'

It is a case of looking after one's general health, to which end a few generalities are applicable. Avoid much stimulant of any kind, either alcohol, tea, coffee, or other kind; avoid big dinners, especially of rich and indigestible food; keep early hours, go to bed early, rise early; live, work, and sleep in well-ventilated rooms; keep the bowels and kidneys in regular action; take frequent baths and plenty of exercise in the open air every day; avoid exposure to sudden changes of temperature and draughts; wear good boots and underclothing; avoid undue excitement; always have something to do, either physical or mental; avoid worry, anxiety, fretfulness, repining, envy, hatred, and malice;

but cultivate a placid, cheerful disposition, and endeavour to take a hopeful view of all things.

Undoubtedly, those born of long-lived families have the best chance, but it is a chance which may be destroyed. There are some people who live a much faster life than others, well expressed by such a phrase as 'burning the candle at both ends.' A modern writer to women in this connection says: 'The modern women eat rich and masculine meals which a generation ago they relegated to men; they now eat anchovies, savouries, olives, foreign cheeses, devilled bones, and hot, spiced, or rich dishes, with the wine appropriate to each; this, with late hours and excitement, produces crow's feet and the marks of high living which are fatal to beauty. It is as hard for a woman to rule in the world of beauty as for a man to make his mark in politics: it is just one round of self-denial; but it is worth it; you cannot eat your cake and have it; and if you indulge in such food your looks must suffer; to live year in and year out on *table-d'hôte* diet is ruinous to health and beauty. Course after course is eaten by unwary women who do not realize that each meal of these highly-seasoned, spiced, and unwholesome foods is hurrying on their age at a galloping pace. The quantity, quality, and circumstances of each meal ought to be considered. Many people who have been to a big dinner overnight will eat sausages and bacon, pork pie, or other equally rich food, for breakfast. Now, circumstances alter meals; a dinner-party overnight calls for a light breakfast of tea and toast or other simple thing. At a dinner-party, without eating too much, one is apt to eat much more than at home, to mix things too much, and perhaps take more than one kind of wine, thus breaking the laws of health. Judicious fasting after a dinner-party may counteract the evil, and the saving grace of roast mutton and rice pudding is beneficial. The dance, with its ices, champagne, and pastry; the ball supper, with its viands, aspics, and sauces, are warranted to produce liver complaint and indigestion. Fortunately, the exercise of the ballroom floor is to some extent a counteracting influence to the ball supper. For two days after a big dinner or ball supper you should eat only plain and wholesome food, take plenty of outdoor exercise, and keep early hours.' The writer goes on to recommend avoidance of worry, to sleep well and at proper times, to avoid over-heated and badly-

ventilated rooms, to eat plain food, to take plenty of exercise, and have regular hours day and night, in order to keep off the appearance and reality of old age.

Many of the customs of life do harm if persisted in. The custom of late dining does harm to many people ; it causes flushing of the face, indisposition for mental and physical exertion, oppression, quick pulse, palpitation, dryness of the hands. Animal food for breakfast is not suitable for people of sedentary occupation or delicate digestion. Highly-spiced and made dishes, curries, turtle soup, and such things, are harmful. They frequently check the secretion of gastric juice or of hydrochloric acid, and thereby hinder digestion ; they cause chronic congestion of the liver, gastric and enteric catarrh, and hæmorrhoids. It has already been pointed out that rich cakes, owing to the amount of butter they contain, are not easily digested, and they cause indigestion and its evils. New bread readily forms boluses which neither the salivary nor gastric juice can easily penetrate ; and the same remark applies to hot cakes and crumpets. Hot buttered toast and pastry are equally pernicious, because the bread cannot be digested until the fat has been dissolved out of it, and headache, giddiness, lethargy, are not uncommon after their consumption. Meat and fish which have been fried in fat come under the same category, and instances may be multiplied so that one might construct an *index expurgatorius* of foods which an individual who wishes to keep youthful and elastic must avoid or eat with great moderation.

When the various stimulants are considered, we cannot refrain from the admission that age is hastened by their excessive use. The milder stimulants, as tea, coffee, and cocoa, can all be taken in moderation. *Excessive* tea-drinking is injurious to the nervous system, causes fluttering of the heart, palpitation, tremors, flushing of the face, owing to disturbance of the sympathetic nerves. Strong tea inhibits salivary action by its tannin, is a frequent cause of indigestion, and predisposes to gout. But the moderate consumption of tea enlivens without producing injurious effects, and assists in the removal of mental and physical fatigue. Coffee is a similar stimulant to tea, and a valuable aid to persons undergoing fatigue. Some people can take coffee without injury who have flatulence and palpitation after drinking tea. On the

other hand, the habitual use of coffee may induce indigestion by checking the work of the stomach for a longer or shorter period, and backache, liver complaint, and hæmorrhoids, are not uncommon. Cocoa has few of the deleterious effects of tea and coffee; it is more sustaining, but less invigorating. The frequent mixture of starch with cocoa causes it to be thicker than tea or coffee; the more concentrated cocoas are thinner, and quench the thirst better. Yerba maté, or Paraguay tea, is lauded by some writers as being free from the unpleasant effects of tea and coffee, and more exhilarating. Guarana, or Brazilian cocoa, also has its advocates; but this is a remedy for nervous headaches, migraine, and exhaustion, rather than a regular beverage.

Much may be said with regard to alcohol. A little good wine or beer with a meal is of service in the economy. It is, however, quite unnecessary for healthy persons, and many diseases are caused by it. Alcohol diminishes the power of the organism to resist disease, and is therefore an agent in shortening life. It actually causes degeneration of the tissues of exactly the same kind as results from old age; it produces atheromatous changes in the bloodvessels and fibroid changes in the tissues, and therefore hurries age upon us. It has been calculated that the system can dispose of about 2 ounces of any one of the spirits per diem, most of which is consumed by oxidation in the body, and the remainder is eliminated by the skin, lungs, and kidneys. Above that amount only 7 per cent. is quickly consumed and eliminated; the remainder lies lurking about the body and doing mischief in it, and is only very slowly eliminated. A glass of good wine, ale, or stout, with a meal encourages appetite and strength partly by the tonic effects of other ingredients than alcohol.

The diet for a person over sixty-five years of age must contain less proteid than for a man in middle life, because there is less wear and tear of the body, and the tissue changes are slower in progress. No fixed rule can be given, but the amount of proteid cannot be cut down to less than 45 grammes or 695 grains of dry proteid material—that is, about one-third of the amount for a man doing ordinary work (Moleschott). This will yield 15 grammes of urea, or the quantity secreted by a starving man, and probably represents *the minimum* of waste derivable from wear and tear of the human machinery. This amount may be obtained

from 7 ounces of lean meat, chicken, or game, or 8 ounces of fish, or $1\frac{3}{4}$ pints of milk, or 6 eggs, or 4 ounces of cheese, or $5\frac{1}{2}$ ounces of lentils, or $11\frac{1}{3}$ ounces of oatmeal, or 17 ounces of bread. The choice, therefore, is not limited, though the amount of each material stated contains the lowest amount of proteid necessary for bodily uses apart from labour.

A daily diet containing 3 ounces of cooked meat or game, $8\frac{1}{2}$ ounces of bread, 10 ounces of milk, and 2 ounces of oatmeal, would contain 997 grains of proteid and yield 332 grains of urea, and would be a moderate allowance.[15]

The quantity of carbohydrate and hydrocarbon in the food cannot be greatly diminished, because the heat of the body has still to be maintained; and the total amount of heat-producing material in the above diet may not be enough, but can be readily increased by more bread-and-butter, sweets, and milk puddings, sugar being of especial value to elderly people as a heat-producer. The following is suggested as a suitable diet, but other simple foods may be added or replace them:

Breakfast: Oatmeal gruel, or bread-and-milk, or one egg; bread-and-butter, tea, coffee, or milk. Dinner (at mid-day): About 2 or 3 ounces of cooked meat or game, or 4 ounces of fish; potatoes, vegetables, bread, milk pudding; a little weak spirit and water or similar drink according to custom; *water*. Tea: Bread-and-butter, tea or cocoa, a little cake or jam. Supper: Oatmeal porridge, or bread-and-milk, or milk pudding, or bread-and-butter with hot milk or cocoa to drink.

It is impossible to lay down any fixed rules except this one, that the amount of animal food and of beans and lentils must be considerably reduced, to at least one-half, and perhaps a third, of what men take in middle life. Great moderation at this period of life is an aid to longevity. It is sometimes hard to convince people how little food is necessary in old age, especially in advanced age, when the processes of life are becoming slower and slower, to maintain the body in health. *Moderation* is construed differently by different people. Some think if they abstain from alcohol they may indulge freely in meat and other highly-nutritious foods. But they cannot continue to do so with impunity, for changes will gradually develop in their bloodvessels and organs, such as atheromatous or fibroid thickenings of the bloodvessels,

which will be followed by apoplexy; or there will be chronic disease of the liver and kidneys or gout. They must, therefore, reduce the amount of meat as well as alcohol if they wish to avoid these troubles. Sir Herman Weber says[16]: 'Few people know how little food is necessary in advanced age to maintain bodily health. Few people who live to more than eighty are large eaters of meat. . . . I have not been able to convince myself that in healthy people a *fair amount* of meat, fish, poultry, or game, causes any bad effects. But most people enjoy better health and live longer who eat only a little meat and a larger quantity of vegetables, to which milk and its preparations may be added. . . . The food should not be bolted or moistened with much fluid during the meal; but it must be thoroughly masticated and moistened by incorporation with the saliva before it is swallowed. Most people in advanced age get thinner, and this is decidedly an advantage to those who have been corpulent, for by loss of weight they may retain their activity longer than they otherwise would do. They feel lighter, breathe freer, and may be more energetic. Some old people count this loss of weight an evil, and endeavour to remedy it by eating more food. But that is wrong; if the person is healthy, nothing need be feared from the gradual loss of weight which is usually evident in persons who reach an advanced age.'

Metchnikoff says[17] old age is a chronic disease in which the pathological change is sclerosis, which may affect the liver, kidneys, and other organs, but is mostly seen in the arteries. The bones grow thin and brittle with advancing age, the tissues atrophy and become replaced by hypertrophied connective tissue. In the brain and nerves, the cells which perform motor, sensory, and intellectual functions, give place to lower or neuroglia cells. The liver cells recede before the invasion of connective-tissue cells. A similar condition takes place in the kidneys and other organs. In short, old age is a struggle between the proper functional cells of the organs and the simple connective-tissue elements, and the latter are the conquerors. Phagocytes, too, aid in the process, as is seen in the whitening of the hair. Normal hair is full of pigment, but at a certain period the cells of the medulla become active, and devour the pigment granules within reach, and so the hair is robbed of colour and becomes

the first manifestation of old age. The increasing porosity of the bones is likewise due to the absorption of the osseous lamellæ by phagocytes. Something may be done by strengthening the most valuable organisms on the one hand, and weakening the phagocytes on the other. But the problem is not yet solved. Three distinguished physicians, however, have given to the public very valuable advice:

Sir Herman Weber formulated the following rules for prolonging life: 'Pure air in and out of the house; moderation in eating and drinking; keep all the organs healthy as far as possible; take regular exercise out of doors, every day, in all weathers; go to bed early, rise early, sleep eight hours; keep the skin in order; have regular work or mental occupation; cultivate a placid, cheerful, hopeful state of mind; avoid anodynes, stimulants, excitement, passion. and all other injurious agencies.

'Some men retire from business at sixty to sixty-five years of age, and lose their grip on life because they take no interest in anything. This is wrong. Such men must find an interest in some object—something outside themselves, and they must keep up a variety in their mental occupation and take an interest in their surroundings; otherwise they are likely to become dejected and melancholy, and little things may burden and worry them.'

Sir James Sawyer recommends: 'Eight hours' sleep; sleep on the right side; keep the bedroom windows open; avoid draughts; take a daily bath at the temperature of the body; eat little meat, and that well cooked; eat fat to feed the cells which destroy microbes; avoid alcohol, which destroys such cells; take daily exercise in the open air; exercise before breakfast; take frequent short holidays; limit your ambition; keep your temper.'

Sir B. W. Richardson also gave the following excellent advice: 'Live on light diet, with milk as the standard food, but varied according to the season; take food in moderate quantity four times a day, the last being a light meal before going to bed; clothe warmly but lightly, so that the body may at all seasons maintain its temperature; keep the body in fair exercise, and the mind active and cheerful; maintain an interest in what is going on in the world, and take a part in reasonable labour and pleasures, as though old age were not present; take plenty of sleep during

sleeping hours; spend nine hours in bed, and take care that the temperature of the bedroom is maintained at about 60° F.; avoid passion, excitement, and luxury.

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PART II

MATERIA ALIMENTARIA

In this part a survey of most of the common and ordinary articles of food is given, including remarks upon their quality and composition, with analyses from reliable sources.

CHAPTER IX

MEAT: THE MAMMALIA

Meat is food in general, but the term is applied particularly to the flesh of such animals as live on the surface of the earth, as cattle, pigs, sheep, deer, goats; whilst **game** is a term applied to many quadrupeds and winged creatures which afford sport to man in catching or killing. The meat of carnivorous animals is tough and ill-flavoured, and is not usually eaten by civilized people; on the other hand, the flesh of herbivorous animals is generally palatable, wholesome, and easily digested. Lean meat consists of muscle without fat.

BEEF.

Beef is the flesh of the Bovidæ, genus Bos, a subfamily of the *Cavicornæ*, or hollow-horned animals. The tribe of oxen are ruminant animals, which chew the cud; their food is vegetable, and they live in herds. There are many wild species, amongst which is the common ox. Some of these formerly lived in the hilly districts of Great Britain, especially in the North of England and Scotland; but now a few only remain in the enclosed areas of large landowners. *Bos taurus*, or the common ox, is the progenitor of the various species of oxen, which are among the most

valuable of our domestic animals. The flesh of oxen, or beef, is one of our principal articles of food, and practically every part of the animal is useful to mankind for various purposes. The present races, breeds, and permanent varieties, have descended from the wild ox by natural or artificial selection—indeed, great has been the influence of the breeder upon them. Some of the varieties are esteemed for their flesh and skins, some for the superabundance of their milk, others for a combination of these qualities. It is needless to enter into a discussion of their relative value for the butcher, dairyman, tanner, clothier, or for draught purposes.

The **quality of beef** depends upon the sex, age, breeding, and feeding of the animal. **Bull-beef** is very dark red, and requires long cooking, and in general is dry, tough, and not agreeable. **Ox-beef** is the best; it is of a bright-red colour, highly nutritious, agreeable to the palate, and digestible. **Cow-beef** is paler and not so agreeable, nor so good for making beef-tea. **Heifer** is held in high estimation by epicures. The flesh of small breeds is much sweeter than that of large ones. Cattle are usually killed at three to four years of age. Small breeds are best for food at three years old; large-breed oxen from four to five, when they are in their prime; cow-beef cannot be eaten too young. The fat of beef should be white or pale yellow; when it is of a decided yellow tint it indicates that the animal was fed largely on oil-cake, and the flesh is not so good for invalids as that of animals fed on roots and pastures. **Veal** or calf should not be killed under six, and is in its prime at ten, weeks; if eaten too young the flesh is certainly not wholesome; it wants firmness, which can only be attained by development of muscular fibre and those animal juices on which flavour and an important part of its nutritive qualities depend. Veal is but little nourishing at the best; it requires a long time for its digestion, and often causes diarrhœa and symptoms which indicate the absorption of albumoses or proteoses into the system. It is by no means a suitable food for the sick or invalid, although veal broth makes an agreeable change with other soups, and is gelatinous. Veal which has had its tissues blown up by the butcher ought to be rejected; to say the least about it, the usual method of doing it is obnoxious, as the breath of the individual who blows it up may be tainted, and he may actually convey disease germs into it.

MUTTON.

Mutton is the flesh of sheep. The domestic sheep is *Ovis aries*, and several varieties; a grazing and cud-chewing animal of the genus Ovis, family Capridæ, or solid-horned animals. Sheep are exceedingly useful animals to man, either naturally so or by long cultivation by human beings. The flesh is an agreeable article of diet, more often eaten than any other meat by many families, and with connoisseurs and medical men it is first favourite, whether they consider its flavour, digestibility, or general wholesomeness.

Sheep are in their prime for food at two or three years of age; wether-mutton, the flesh of the castrated animal, is in perfection at three to four years, and is by far the sweetest and most digestible; while ewe-mutton is best eaten young, not more than two years old.

The varieties of sheep are very numerous, and it is unknown from what wild species they have been domesticated. The South Downs of Sussex and Hampshire, the Cotswolds, the Lincolns, the Leicesters, the Cheviots, and the black-faced, are among the principal British varieties. As a rule, the larger the frame of the animal the coarser the meat; the smaller the bones and the finer the breed, so much more delicate will be the flesh. The difference in the quality of the flesh as a food, shown by its flavour and tenderness, depends very largely upon the variety, but equally important are the pastures and the breeding-ground—witness the fine flavour of the mutton grown upon the thymy heaths of Sussex.

Lamb is the young of sheep killed at twelve weeks old or more. Owing to the large amount of moisture in the tissues of all young animals, the flesh of lamb and veal is more prone to become tainted and spoilt than that of more mature animals, which is closer-grained and drier. The juice of the tissues easily escapes when the animal is cut into joints, and this is frequently removed as it exudes from the interstices, because it forms a very agreeable medium for the growth of bacterial germs; some nutriment is lost by its removal, to avoid which the cook occasionally sprinkles the joint with flour, to absorb and preserve the fluid, which consists of lymph or serum from the tissues. The reshness of lamb can be told by the dilated pupil and brightness

of the eye, by the muscular rigidity and firmness of the kidneys, which indicate wholesomeness, freshness, and death by the hands of the butcher.

GOAT.

Goats consist of many species of Capræ; they are about the size of sheep, and exist on the scanty and coarser food of rocky and mountainous regions, the inhabitants of which keep them for their milk—an exceedingly nourishing and sweet fluid—as well as their flesh, which is to them a valuable article of food.

VENISON.

Venison is the flesh of deer (Cervidæ and varieties), which are ruminant animals, existing in many parts of the world; few now exist in Britain, and they are enclosed mainly in the parks of aristocratic houses. The flesh is dark, wholesome, and delicious. Antelopes of many kinds are eaten as venison wherever they appear.

PORK.

Pork is the flesh of hog (*Sus scrofa*); it is eaten fresh, salted, or smoked, as bacon, ham, sausages, and pies. The fat of pork is lard, a soft neutral white fatty substance, which consists of olein, stearin, and palmitin (see 'Fat of Meat').

The young of pig is a dainty dish, highly prized by epicures; the animal should not be more than four or five weeks old to be at its best. Charles Lamb, in the 'Essays of Elia,' says: 'Of all the delicacies in the whole *mundus edibilis* I will maintain it to be the most delicate. . . . I speak not of your grown porkers . . . but a young and tender suckling under a moon old . . . he must be roasted! There is no flavour comparable to that of the crisp, tawny, well-watched, not over-roasted *crackling;* the very teeth are invited to their share of pleasure at this banquet in overcoming the coy, brittle resistance, with the adhesive oleaginous—oh, call it not fat! but an indefinable sweetness growing up to it—the tender blossoming of fat—the cream and quintessence of the child-pig's food; the lean no lean, but a kind of animal manna, or, rather, fat and lean so blended and running

into one another that both together make but one ambrosian result or common substance.'

THE RODENTS.

These mammalia afford excellent sport to the hunter, and many are esteemed for food. The **hare** (*Lepus timidus* and varieties) lives entirely upon vegetable matter, and is highly nutritious and stimulating; its flesh is dark and dry in comparison to that of rabbit, and is in some respects superior, being more savoury and of higher flavour. The rabbit (*Lepus cuniculus* and varieties) is both wild and domesticated; its flesh is whiter and more juicy than hare's, and is largely used for food. The rat (*Mus rattus*, *M. decumanus*, and other species), when corn and similar materials are eaten, is said to be delicious. They are cooked in pies and other ways. In South America and the West Indies these animals are replaced by cavies, such as *Agouti*, *Capybara*, *Coypu*, and *Paca*, which are eaten.

GENERAL CONSIDERATIONS.

The dark flesh of beef, mutton, venison, and hare, contains somewhat more nutriment, and is decidedly more stimulating, than the white flesh of lamb, veal, rabbit, chicken, partridge, pheasant. The flesh of animals which roam in search of their food is generally allowed to be of finer flavour than that of animals which are enclosed in a stall or confined area.

No butcher's meat is so digestible and tender as **mutton**; when well conditioned its fibres appear to possess just that degree of consistence which is most congenial to the stomach, and in England it is perhaps more frequently eaten than any other animal food. **Beef** is not so easily digested—its texture is firmer—but it is equally nutritive; its tenderness and flavour depend somewhat upon the length of time the meat has hung since killing and the method of cooking it. In proportion to age, its flesh is coarser and firmer. The distribution of fat is important: in old animals it is collected chiefly in masses or layers external to the muscles and around the internal organs; in young ones it is interspersed among the muscular fibres, and gives the flesh a marbled appearance, which is always a desirable quality of butcher's meat. The more difficult digestion of pork is largely

due to the saturation of its fibres with fat during cooking, and frequently to fatty degeneration; and the easier and more rapid digestion of chicken, pheasant, rabbit, etc., is largely owing to the absence of fat from their tissues. The **sex** of animals modifies the quality of flesh, that of the female being more delicate and finer than that of the entire male animal at the same age, whose fibres are firmer. The influence of the genital organs is very extraordinary; it is stated that the flesh of a female is improved by the removal of the ovaries, or **spaying**; and as regards the male, every day the testes are permitted to remain injures the delicacy of the veal of a bull-calf; and in an animal not castrated until after puberty the flesh always retains the coarseness of the entire animal. The same remarks apply equally to the flesh of sheep and other animals, even birds.

THE CHOICE OF MEAT.

That which is known to be the flesh of an unsound animal must be rejected. Lean meat ought to be firm, elastic, and mixed with fat (**marbled**), in young, healthy, well-fed animals. The lean should be of a deepish-red colour, not dark, livid, greenish, or pale, nor soft and flabby; it should have the characteristic odour of meat. The lean of animals killed while in a state of fever or inflammation is dark or otherwise discoloured; it is more moist than ordinary; the spaces contain pus or other fluid, which soon undergoes putrefaction. Meat which has begun to putrefy is soft, pale, flabby, and has an unnatural odour, perceptible on a knife pushed deeply into it, and which becomes apparent when the meat is warmed by cooking. When meat is good the flesh adheres firmly to the bone; the fat is firm and yellow, has no red points (blood), is neither particularly greasy nor friable to the touch, but is moderately unctuous. When the animal is emaciated the flesh adheres but slightly to the bone, its fibres are contracted and dry, and the fat is friable and shrunk. When meat is stale or game is too 'high,' there is little doubt that changes have taken place within it from bacterial action, whereby certain alkaloidal substances of the nature of ptomaines and leucomaines (*q.v.*) of an exceedingly poisonous nature are produced. When these are taken into the body with the food they are absorbed, and serious, even fatal, results may follow.

AVERAGE COMPOSITION OF MEAT.

	Nitrogenous.	Fat.	Water.
Beef (average of parts) ...	17·12	27·33	55·5
Veal	19·55	5·40	75·5
Mutton (König)	18·11	7·7	75·9
,, very fat	14·8	36·39	47·9
Venison (Bibra)	19·24	1·3	74·63
Pork, fat (König)	14·54	37·34	47·40
,, lean (König)	19·91	6·81	72·57
Tripe	13·2	16·4	68·0
Chicken	23·35	3·21	74·44
Partridge	25·35	1·45	71·69
Fat goose	15·89	45·61	38·02

The *composition* of cooked meat is 27·5 per cent. of proteid material, 15·5 per cent. of fat, 3·0 per cent. of salts, and 54 per cent. of water. Raw meat contains 22 per cent. of proteids, 17 parts of which are digestible and 5 parts indigestible, the difference being due to loss of water in cooking. Bones contain a large amount of albuminoid material, mainly as—gelatine, 24 per cent.; fat, 11 per cent.; mineral, 48 per cent. A most nourishing soup can be prepared by boiling bones for a lengthened period.

Lean meat consists of the muscular fibres, which contain many things; the proteids are myosin-albumin, the chief constituent in the active part of muscle; serum-albumin from the lymph and blood in its vessels; keratin and elastin from the bloodvessels; special colouring materials; extractives or products of disintegration (as creatin, creatinin, sarkin and sarcolactic acid, inosinic acid, taurin, xanthin, hypoxanthin, uric acid, and urea), which give the characteristic odour and flavour to roast meat and broth. The fats are lecithin and cholesterin. The carbohydrates are inosite, dextrin, dextrose, and glycogen. The salts are chiefly phosphates and chlorides of soda, potash, lime, iron, and magnesia.

Fat meat consists of fat cells, held together by a loose stroma of connective tissue and vessels. The internal fat of the abdomen of sheep and oxen is called *suet*—a firm, smooth, white, odourless substance of a similar composition to other fats. Fat is a hydrocarbon—an oily, concrete substance, composed of carbon,

hydrogen, and oxygen, deposited in animal tissues. It consists of the organic acids, stearic, palmitic, and oleic, combined with the radical glyceryl to form stearin, palmitin, and olein. Oil is a neutral body in animal and vegetable tissues, which is liquid at ordinary temperatures, and is also composed of stearin, olein, and palmitin in various proportions. **Palmitin** is a solid crystalline substance contained in palm-oil and many other fatty substances. **Stearin** is the hard and chief substance contained in suet and many other animal fats. It is a stearoptene or solid oil, so called in contradistinction to **olein**, another fatty material contained in many fats and oils, which is liquid, and called an 'oleoptene.' The fat or suet of beef and mutton is a combination of the solid fats palmitin and stearin, mingled with the liquid olein in such a proportion that the fat remains liquid in the cells of the living body, and outside of it too, when kept at the temperature of the blood. The greater the proportion of stearin in any fat, the more solid the mixture will be at ordinary temperatures; but the greater the proportion of olein, so much the more liquid will the fat be at ordinary temperatures.

The chief use of fat in the animal economy is to yield heat and energy by its oxidation; it also affords protection to various delicate structures, and gives to the body that contour or curvature which is called the line of beauty. *The use of fat in our food is a necessity;* its presence promotes the flow of the bile and pancreatic juice, and it enriches the chyle. When fat is entirely absent from the food these secretions are deficient, consequently the food is not properly digested, nor the functions of the intestines duly performed; indeed, an entire absence of fat from the food leads to malnutrition, and creates a predisposition to such diseases as scrofula, tubercle, phthisis, and other wasting diseases. An excess of fat in the diet is not of much consequence, as it may pass out of the system with the excreta. Fat can be manufactured in the body, causing an increase of weight, by an excessive use of lean meat or a diet rich in starch or sugar. An excess of these foods when assimilated may lead to the deposition of fat around important organs and in the subcutaneous tissues, thereby inducing obesity and other ailments; nevertheless, it is deemed advisable that fat should always be an article of food, for its absence is not well borne, and leads to rapid loss of flesh and strength and

vitality, and lays the foundation for many diseases. That there is *an equal necessity for proteid* material, be it meat, fish, eggs, milk, peas, beans, lentils; that man, in common with all other animals, cannot assimilate unorganized nitrogen, but is dependent upon proteids for his supply; that the absence of proteid food cannot be tolerated; that the nitrogen it contains is a necessity for the continuance of life; that people who do not eat a moderate amount of meat, fish, game, or other animal substance, nor take such substitutes as peas, beans, or lentils, suffer from *proteid starvation* in consequence, with ill-health, an enfeebled frame, and many evils which follow in their train, has already been shown.

The time necessary for the digestion of meat depends entirely upon its firmness, richness, moisture, or dryness—upon its proper mastication and subdivision; and, while the dangers of uncooked or under-cooked meat are well known, it should also be observed that over-cooking delays its digestion. The complete digestion of pork requires five hours; beef, four hours; roast mutton, three and a half hours; boiled mutton, three hours; lamb, about two and a half hours; chicken, rabbit, pheasant, about two and a half to three hours; venison, two hours; tripe, one hour. The digestion of animal food is well provided for in the human economy, and the process has been dealt with in a previous chapter. Briefly, the digestion of lean meat begins in the stomach, where the gastric juice dissolves the connective tissue, separates the muscular fibres, liberates the fat, and converts some of the proteid through various stages into peptone. The latter, being soluble and highly diffusible, is absorbed into the blood through the coats of the stomach, and re-formed into some kind of proteid, probably serum-albumin. Such meat as is not peptonized in the stomach passes with the chyme into the intestines, and is completely peptonized by the enzymes of the pancreatic fluid. Fat is liberated from meat by the solution of its albuminous coverings, and passes into the intestines with the chyme; it there meets with the bile and pancreatic fluid, which emulsify and saponify it, and becomes absorbed. During saponification oils and fats are split into glycerine and fatty acid; the acid, joined with an alkaline salt, enters the blood; glycerine is likewise absorbed, and fat is once more made from

the two constituents. Glycerine which is not thus utilized is further decomposed in the system into proprionic, formic, and other acids; and the urine of persons taking glycerine as a food or medicine often contains a reducing agent which gives the test for sugar, but it is not sugar. Glycerine is prepared as a commercial product from fat during the manufacture of soap and other processes. It is sometimes prescribed in large doses for phthisis and other wasting diseases in place of cod-liver oil with the idea that it is nutritive, and may contribute to the formation of fat in the body, but results are very varied, and on the whole not encouraging; indeed, its continued use in large doses may be injurious by causing a solution of the red corpuscles, a diffusion of hæmoglobin in the plasma, and consequent hæmoglobinuria. Fat is taken into the body in many kinds of food. It forms a large percentage of all kinds of meat, and is taken nearly pure in butter, suet, lard, dripping, and oil. It forms 2 to 8 per cent. of milk, 12 per cent. of eggs, 25 per cent. of cheese, 5·5 per cent of oatmeal, 6·7 per cent. of maize, and a smaller percentage of bread and vegetables. The fat consumed in our food is not deposited directly in our tissues, but undergoes some elaboration or chemical change before it becomes a part of us, as is evidenced from the changes it undergoes in constitution during digestion. Neither does the fat contained in the food account for all that is deposited in the tissues; on the contrary, it is formed in the body from the consumption of meat, sugar, and starch, for men and animals whose diet consists solely of starches and sugars, or things containing them, 'lay on flesh,' their increased weight being due to formation of fat within their body. In like manner it has been proved experimentally that 50 per cent. of the proteids consumed by animals may be converted into fat. Foster says: 'Proteid is split in the body into a urea moiety and a fatty moiety. The urea moiety is discharged at once, and such of the fatty moiety as is not made use of is stored up in the body as adipose tissue.' When a larger quantity of food is consumed than is required for immediate use, a portion of it is stored up as fat in various tissues and organs, and glycogen accumulates in the liver.

Glycogen is animal starch ($C_6H_{10}O_5$), and is isomeric with starch and dextrin. It is found in all growing cells and tissues,

in colourless blood cells, and especially in the cells of the liver. The proportion in the liver varies under different circumstances and in different animals from 2 to 12 per cent.; the liver of domestic fowls often contains as much as 13 per cent. When an excess of any kind of food is taken, glycogen accumulates in the liver in large quantities; carbohydrates, as sugar and starch, cause the greatest formation, proteids give rise to some, fat to none, gelatine to none, and a mixed diet causes the greatest accumulation. Glycogen is the carbohydrate of which the liver is the great storehouse, for immediate or future use, for the production of heat and energy when food is scarce or unusual demands are made upon the body. There is a constant proportion of 0·5 per cent. of sugar in the blood, by which it is carried to every part of the body for producing heat and muscular force, the source of which is the liver.

We thus perceive that our fleshy food contains, besides proteid and fat, important substances distributed through its parts in various proportions—as glycogen in the liver; products of the disintegration of proteids in liver, kidney, and sweet-bread; phosphorus compounds, especially in large proportion in brain and nervous tissues; iron occurs in the red flesh of animals, and is especially abundant in the liver, where it exists in several peculiar compounds of the liver cells, and is probably derived from the disintegration of the hæmoglobin of the blood coursing through it, and is in turn discharged from the system with the bile.

References: Parkes, 'Hygiene and Public Health.' Yeo's 'Food in Health and Disease.' Foster's 'Physiology,' vol. ii. Power's 'Human Physiology.'

CHAPTER X

AVES: THE BIRDS

A very great variety of food is furnished to mankind by birds of the Natural Order Carinata, the flying birds with a keeled sternum. The class of Gallinaceæ includes the domestic fowls, pheasants, partridges, quails, peacocks, turkeys, guinea-fowl, grouse, and many others; the subclass Columbæ contains many varieties of pigeons

the class of Natatores, or swimmers, yields the ducks, geese, widgeons; the Grallæ, or waders, include snipe, plover, water-hen; and the Passeres rooks, larks, finches, thrushes, starlings, linnets, sparrows. There is a wide field of supply, and a great choice to be had in the proper seasons. The domesticated birds have white flesh, and are said to be less nutritive and stimulating than the wild birds. Wild species, like partridges and grouse, have dark flesh, which is more highly flavoured, even slightly bitter, from their eating the tops of birch, heather, and mountain berries, which give a distinctive but not unpleasant flavour to their flesh. As food they are more nutritious, heating, and stimulating than the white flesh of fowls, pigeons, or pheasants. The flesh of birds, like all young animals, contains more nucleo-albumin than that of beef or mutton, and for that reason is not suitable for certain patients. Dark-fleshed ones have been supposed to contain more extractives than white-fleshed ones, but it has been proved that the difference is so slight as to be negligible in making a dietary for patients. The reason why chicken or pheasant, for instance, is more easily digested than beef or mutton is because their muscular fibres are free from fat and have very little connective tissue, and are, therefore, more readily attacked by the gastric juice; duck and goose, on the other hand, have much oil in their flesh, which renders them more difficult of digestion, and the oil is of a more or less peculiar character, and is apt to disagree with many people.

The whole gallinaceous family makes a valuable addition to our *materia alimentaria*. From the smallest to the largest their flesh is light, full of flavour, and fitted equally for an invalid or robust person. Much, of course, depends upon their nutrition, age, sex, and time since they were slaughtered, the flavour and tenderness of some being improved by 'hanging' for a few days prior to cooking, during which time a *game flavour* is developed. Pasteur always asserted that the change which produces the game flavour takes place in a pre-putrefactive stage; but the birds want watching lest it degenerate into decided putrefaction, for the line of demarcation is very narrow, and may be easily passed. The putrefactive bacteria are not themselves disease-producers, and this accounts for the fact that game when eaten hot is often harmless, even though it be very 'high'; but the heat

which destroys bacteria may not have destroyed the bacterial ferments, so that cold game, even when previously well cooked, sometimes produces alarming symptoms, due to violent inflammatory irritation of the alimentary canal, with cramp of the extremities and failure of the heart's action, because the bacterial ferments have acted upon the albuminous portion of the flesh and produced albumoses, leucomaines, or ptomaines, which have a physiological action very similar to the poisonous alkaloid known as muscarin.

Fowls, pheasants, partridges, turkeys, grouse, quails, and all the other members of this numerous family, may be ranked amongst the most nutritious of our foods, innocent and easily digestible, if well kept and free from putrefaction. A well-fattened fowl (Gallinæ and many varieties) is always handy and acceptable to the cook, for it can be cooked in every way and shape. The flesh of a young chicken is the most delicate and easy of digestion of any animal, excepting a few of the lighter kinds of fish, and its entire freedom from irritating qualities renders it fit for an invalid or a person whose stomach is naturally weak and unable to digest stronger meat. Age and sex influence the quality of a bird's flesh as it does that of other animals; in infancy cocks and hens are equally toothsome, but the flesh of male birds toughens quicker than that of females; a year-old cock is fit for little else than soup, but at that age a hen is tender, though substantial. Age does not affect capons or castrated male birds as it does entire ones; indeed, the flesh of a capon remains as juicy, tender, and well-flavoured at three years of age as that of a chicken; there is scarcely a more delicious dish.

Pheasant (Phasianus and varieties) has white and tender flesh; when hung for a week after killing it has a flavour between chicken and venison; but authorities state that unless it is kept for the proper tenderness and game flavour to develop it differs little from the common fowl—that, indeed, a pullet would be preferable and a quail surpass it; hen birds are the most delicate. Partridge (*Perdrix cinerius*) should be eaten young; old ones are valueless. The flesh of quail (*Coturnix vulgaris*) is excellent food. Grouse (Tetrao and varieties), blackcock or moorfowl, woodcock, ptarmigan, ortalan, and many other birds, are very nutritious. Peacock (*Pavo cristatus*) has a fine tender

flesh, which was formerly much esteemed. Turkey (*Meleagris gallo-pavo*) is delicate, tender, nourishing, and of excellent flavour; age depreciates its value for the table. The flesh is whitish-gray, free from excessive fat, and therefore preferable to goose. Guinea-fowl (*Numida meleagris*) has flesh of fine flavour and easy of digestion; not so white as that of the domestic fowl, but approaching that of the pheasant, for which it is an excellent substitute. Young pigeons (Columbæ) are very wholesome. The Natatores afford many specimens which are in frequent demand for the table—as the goose (Anser and varieties), which lives chiefly on land and feeds upon grass, etc.; the wild duck (*Anas boschus*), also called the mallard, which is the parent of the common duck (*A. domesticus*); and the widgeon (*Mareca penelope*) has always been in request for the table. The flesh of these birds is darker, richer in fat, and not so easily digested as that of Gallinaceæ; the oil is of a peculiarly strong odour, and some people cannot digest it: it makes them bilious. The flesh of duck, though oily and rank, is easier of digestion and not so gross as that of goose. Among the Grallæ, the snipe (*Scolopax gallinago*) has a fishy taste, derived from its food; but the water-hen (*Gallinula chloropus*) has well-flavoured flesh, and the plover (varieties of *Charadrius fluviatilis*) is a favourite with many people, a game flavour being developed by 'hanging.' The Passeres include many which have been eaten for food—as the rook (*Corvus frugilegus*), larks (varieties of *Alauda arvensis*), finches and linnets (Fringillidæ), starlings (*Sturnus vulgaris*), thrushes (varieties of Turdus), and sparrows (*Pyrgita domesticus*). Some of these, especially the rooks and larks, are much sought after, the flesh of the latter being esteemed a great delicacy.

Birds' eggs are good for food in any form, boiled, poached, fried, in omelettes, custards, egg-flip, puddings, or prepared in any other way. Those of the domestic fowl are very delicious and highly esteemed when new laid, but the quality depends likewise upon the feeding of the birds. Turkey's eggs are nearly as mild as those of the common fowl. Plover's and lapwing's eggs are nutritive, and thought exceedingly delicious by some people. Guinea-fowl's eggs are smaller but more delicate than hen's eggs. Goose's eggs are well flavoured, but duck's are very rich, and

both are heavy and oily. Wild birds' eggs generally taste of the food they eat; sea-fowl's have a fishy taste.

In point of nutriment and digestibility, eggs rank very high indeed; they contain a large amount of albumin and fat. But it does not follow that they are food for everybody; on the contrary, some persons cannot digest them, and they make others bilious. The digestibility of eggs depends upon the cooking; raw eggs are not so easily digested as when the albumin is slightly coagulated by heat. A poached egg, or one which is boiled until the white is just set, is the easiest of digestion; but the digestibility diminishes in proportion to the hardness to which it is cooked. A fried egg is the hardest of all to digest, the indigestibility being increased by cooking it in fat. Raw eggs are laxative, boiled ones are constipating.

The composition of the egg of the domestic fowl, being most in demand, may be taken as a type. The yolk forms $\frac{3}{10}$, white $\frac{6}{10}$, shell $\frac{1}{10}$; the average weight is 2 ounces. Eighteen eggs would be required to provide a man with enough nutriment for flesh-forming and energy-producing elements for an ordinary day's work. Parkes gives this composition: Proteid, 13·5 per cent.; fat, 11·6; and water, 73·5. Power gives a separate analysis for each part: The white consists of albumin, 13 per cent.; globulin, 0·134; salts, etc., 0·766; water, 86. The yolk contains vitellin (proteid), 14·0 per cent.; fat and lecithin, 30; nuclein, 1·5; cholesterin, 1·75; salts and colouring matter, 0·75; water, 52. The average egg contains about 0·045 per cent. of phosphorus, the white has only 0·031, but the yolk 1·279 per cent. in vitellin, lecithin, nuclein, phosphates, and glycerophosphates.

REPTILIA AND BATRACHIÆ.

The turtle is the chief member of the Reptilia used for food. The green turtle (*Chelonia myades*) is much prized for making soup; its flesh is highly esteemed, and furnishes a wholesome and palatable food for mariners and others in every latitude of the torrid zone. Turtle soup is highly stimulating and exceedingly nourishing. Terrapins are tortoises eaten in warm, temperate, and tropical climates; iguana and agama are lizards eaten in South America and Africa. Among Batrachians, *Rana esculenta*

is the frog whose hind quarters are highly esteemed as food and commonly eaten in France and Germany.

THE FISHES: PISCES.

Among the principal fishes commonly used for food are the following:

1. The Bony Fishes, or Teleostei.

Subdivision Malacopteri: (*a*) Salmonidæ, the Salmon family. Salmon (*Salmo salar*) is both a sea and fresh water fish, its normal locality being about the mouth of rivers, up which it ascends in the season for spawning. The young go out to sea when they are only a few ounces in weight, and return to the river after a few months transformed into well-developed fish. They grow to 15 or 30 pounds weight in two or three years, and at that age make a delicious dish for the table and an important article of commerce. Salmon is perhaps the most nutritious fish of the genus; it contains 15 per cent. of proteid and 6·5 of fat, but it is heating and oily, and not very digestible; most persons find it necessary to take vinegar, lemon, or some other condiment with it; lobster sauce is a frequent accompaniment, and adds to the indigestibility of the meal. Salmon-trout (*S. trutta*) is of the same family, and ranks next to salmon, which it resembles in form and colour. It is not so rich and oily as the former, is easier of digestion, but less nutritious. Trout (*S. fario*) is the common or gray trout; there are other species also—all are estimable food. Candle-fish, caplin, and namaycush, are highly esteemed members of the family in America. Char is *S. umbla* and others of the Salmonidæ which inhabit lakes of pure water—most delicious fish. Grayling (*Thymallus vulgaris*), about 16 or 18 inches long, lives in clear and rapid streams, and forms excellent food. The whitefish of North America (*Coregonus sapidus*, genus Coregonus) is near to salmon in rank, and is by many people esteemed the finest of all fish.

(*b*) Clupeidæ, the Herring family. There are two species of herring (*Clupea harengus*, or the common herring, and *C. leachii*, which is shorter). The common herring lives in latitudes from Kamtschatka in the North to Carolina in the South. It is very productive, 68,000 eggs having been found in the roe of one

female. They swim in shoals near the surface, and seek the coast to deposit their ova for hatching. They are easily caught by nets, and the herring fishery is an important and lucrative business. They are nutritious, and contain 10 per cent. of proteid and 7 of fat. Whitebait (*C. alba*) is a small fish of the herring family, 2 to 5 inches long; it abounds in large rivers, as the Thames and Humber; much prized as an article of food. Sprats (*Harengula sprattus*) are also a delicious, well-flavoured, and wholesome fish. Shad (*Alosa vulgaris* and other species) attains to a length of 3 feet; the British species have a rather dry flesh and are not much prized; but those of America are much nicer, being highly esteemed and eaten in quantities. Sardines (*C. sardinus*) are small fish esteemed for their flavour; they are salted, dried, or scalded in hot oil, with or without spices, and preserved in hermetically-sealed tins. Pilchards (*C. pilchardus*) are also small fish, and, being preserved like sardines, form a considerable article of commerce. Anchovy (*Engraulis encrasicholus*) also belongs to the Clupeidæ; there are several species of small size which live in the Mediterranean and tropical seas; used chiefly for pickles, paste, and sauce. Anchovy sauce is made by pounding them in water, simmering with cayenne pepper, and rubbing them through a sieve. Paste is similarly made. Sometimes colouring and other matters are added. Anchovy paste or sauce is not always what it is represented to be, as sprats or other small fry have been used to make it up, being coloured, flavoured, or even mixed with red clay.

(*c*) The Gadidæ, or Cod family, supplies us with several important and highly useful members. The cod is *Gadus morrhua* or *Morrhua vulgaris*, and other species. This is a teleostean fish inhabiting northern seas between 45° and 66°, and especially abundant in the seas of Norway and Iceland, about the banks of Newfoundland and New England, and the seas north of Scotland in the neighbourhood of the Orkneys. They are an important article of food; the best are caught from February to April; some are very large, and may attain 100 pounds weight. The oil obtained from the liver is pale to brown in colour, and is justly esteemed a valuable agent in the treatment of scrofula, phthisis, rheumatism, and other diseases. Hake (*Merlucius vulgaris*) belongs to the cod family, and is found in the shoals of

herrings on which it preys. Salted and dried, it is a palatable article of food. Haddock (*Gadus æglefinus*), smaller than cod, is also a well-known member of the family, which breeds in immense numbers in northern seas, and is a considerable article of food. It is best and most palatable when only of middle size; fresh haddock is intended whenever it is ordered for an invalid. Whiting (*Merlangus vulgaris*) likewise belongs to them, and abounds on British coasts; it excels all the other members in delicacy and lightness as an article of food.

(*d*) Anguillæ, or Eels, are both fresh and sea water fish, but conger-eel is entirely marine. Both are used for food; their flesh s firm and makes a substantial meal, but is objectionable to some persons because it contains a large proportion of oil and is somewhat indigestible. Eels contain 13 per cent. of proteid and 28 of fat.

(*e*) Cyprinidæ, or the Carp family, contain both marine and fresh-water fishes, many of which are prized by fishermen. Carp (*Cyprinus carpio*) is an excellent fish which grows in ponds, and may attain a length of 4 feet. Roach (*C. rutilus*) lives in lakes, ponds, and slow streams; its average weight is less than a pound, for which reason it is not much esteemed for the table, but it is a great favourite with anglers. Bream is the name of several fresh-water fish belonging to this family; the carp-bream (*Abramis-brama*) sometimes attains a weight of 10 or 12 pounds. Tench (*Tinca vulgaris*) is a small fish in the lakes and ponds of Europe, 10 or 12 inches long; its flesh is coarse and insipid. Dace (*Leuciscus vulgaris*) is also a small fish in deep, clear waters and quiet streams; although good sport, it is not a very useful food. Gudgeon (*Gobio fluviatilis*) is another small fish of fresh waters, little used for food, but more as a bait for pike.

(*f*) The Pike (*Esox lucius*) is a malacopterygious fish which lives in deep fresh water, and is very palatable food. Perch (*Perca fluviatilis*) belongs to the Acanthopterygii; it lives in the rivers and lakes of temperate regions; its flesh is firm, but a delicate food. Loach is a smal lfish (*Cobitis barbulata*, genus Cobitis) which inhabits the clear streams of England, and is esteemed a dainty food.

(*g*) The Scomber or Mackerel family. Mackerel (*S. scomber*) is a well-known table fish of excellent qualities, which inhabits

all European seas; there are several species, and, like herrings, they are caught when they approach the coasts for spawning. Mackerel is a type of many fishes forming the family of Scomber, mostly excellent for the table, of which the following are examples: Tunny (*Thynnus vulgaris*), a close ally of mackerel, lives in shoals in the seas of all temperate and warmer parts of the earth; it may grow from 4 to 20 feet long and weigh $\frac{1}{2}$ ton; its flesh is a great delicacy, somewhat resembling veal, and much in request.

(*h*) The Doree, or John Dory (*Zeus Faber*), is a fish of the seas, seldom exceeding 15 or 18 inches, but esteemed very delicate eating. Ling (*Lota molva*), of the genus Lota, abounds around the coasts of Britain, grows to 4 or more feet long, and is eaten fresh or salted. Mullet—there are two kinds belonging to the Acanthopterygii. The gray mullet (*Mugil capito* and varieties), found around the coast, ascends the rivers or seeks shallow water in the spring; it has a habit of boring in the mud or sand for its food; it grows to 18 or 20 inches long, and may weigh 12 to 15 pounds. The red mullet—surmullet—is *Mullus barbatus*, which inhabits the Mediterranean Sea; it is smaller than its gray relative, and only attains about 1 foot in length; it has always been esteemed a delicacy by epicures, and was extravagantly prized by the Romans.

(*i*) The Pleuronectidæ, or Flat Fishes. Flounder (*Platessa flesus*) is the type of the flat fishes, some of which are important articles of food. The flounder is one of the most common flat fishes; it is found in the sea, near the mouth of large rivers and around the coasts, but mostly where the bottom consists of soft sand or mud. Flounders live and thrive in the sea, in fresh or brackish water, and have been transferred from one to the other; they feed upon small fishes, worms, and water insects, and may attain a weight of 4 pounds. Halibut (*Hippoglossus vulgaris*) is much larger, and may attain any weight up to 300 pounds. It is a common article of food; the flesh is firm, but some parts of the body are fat, tender, and delicious. Turbot (*Rhombus maximus*) is the largest of flat fishes, after the halibut; many of a few pounds in weight are brought to the table, but they attain 60 or 70 pounds in weight. It is exceedingly light food, and highly esteemed for the table. The American turbot (*Rhombus maculatus*) is equally delicious, and not so large. Brill (*Pleuronectes*

rhombus) resembles turbot, but is inferior to it in size and quality. Plaice (*Platessa vulgaris vel pleuronectes platessa*) is more flat and square than halibut, grows up to 7 or 8 pounds in weight, and is highly esteemed as a light article of food. Sole (*Solea vulgaris*) is an oblong flat fish which abounds in all seas near the coasts of Europe, except where the bottom is sandy; sometimes they ascend the rivers and thrive well in them; they grow to a weight of 6 or 7 pounds, and are a wholesome and delicious food of a light character, containing about 11 per cent. of nitrogenous matters and less than 1 per cent. of fat.

THE COMPOSITION OF COOKED FISH.

Name.	As served at Table.				100 Parts of the Dried Flesh, absolutely Water-free, contained:		
	Waste, Bone, etc.	Gelatine.	Water.	Nutrients.	Proteid.	Fat.	Carbohydrate.
	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.
Herring, fresh	11·7	0·63	52·9	35·5	67·0	25·0	—
Herring, salt	—	—	46·0	53·9	38·0	22·0	17·0
Sprats ...	17·9	0·90	61·5	19·7	—	—	—
Sardines ...	4·9	—	42·1	52·9	—	—	—
Salmon ...	5·9	0·53	61·0	32·0	55·6	29·5	14·8
Salmon peel	17·8	0·21	35·5	48·4	—	—	—
Salmon, Californian ...	—	—	61·9	38·1	56·5	34·2	4·3
Trout ...	8·2	0·55	67·1	24·1	80·0	8·4	4·6
Smelts ...	18·8	0·38	65·2	15·5	—	—	—
Eels	11·6	1·09	53·2	33·9	42·9	44·6	8·9
Red mullet ...	24·2	2·41	50·0	23·2	66·2	24·5	9·7
Roach ...	24·3	0·65	56·5	18·4	79·1	15·0	6·2
Gurnard ...	46·3	0·65	39·1	13·9	89·1	1·8	14·7
Mackerel ...	10·5	0·25	65·2	24·0	62·3	25·7	13·9
Tunny ...	—	—	69·3	36·5	66·0	30·6	—
Cod	15·9	0·43	63·7	19·7	91·5	1·1	6·6
Cod, salt ...	6·1	0·33	67·6	25·9	—	—	—
Haddock ...	35·1	0·80	46·4	17·6	79·5	1·2	13·1
Whiting ...	21·5	0·86	61·2	16·3	79·5	1·8	17·5
Hake ...	7·8	0·26	78·0	13·8	81·3	5·6	13·6
Turbot ...	31·2	0·59	53·0	15·1	84·7	4·7	11·8
Brill ...	8·1	0·19	57·4	34·1	93·7	1·6	—
Halibut ...	6·8	0·03	69·3	23·7	79·6	15·8	—
Plaice ...	—	—	79·8	20·1	75·1	9·8	11·5
Sole	22·0	0·74	61·1	16·0	86·7	1·7	11·8
Lemon sole ...	26·1	1·42	56·5	15·8	69·8	12·8	14·8
John Dory ...	20·9	0·98	60·8	17·2	69·5	8·5	14·2
Oysters ...	—	—	77·7	22·2	65·4	7·7	18·3

2. **The Elasmobranchii, or Cartilaginous Fishes.**

Skate, or ray (*Raia batis*), is the principal cartilaginous fish used for food; it is depressed and flat, of rhomboidal form; its flesh is gelatinous and highly nutritive. Sturgeon (*Acipenser sturio*) is a ganoid fish whose flesh is wholesome and agreeable food, delicate, well-flavoured, and resembles veal; the air-bladder is made into the finest isinglass, and consists of almost pure gelatine; the roe is made into caviare, a rich and highly nutritious food. Lamprey is an eel-like fish (Petromyzon), of the order Marsipobranchii; there are river and sea varieties, the latter attaining a weight of 4 or 5 pounds; they attach themselves to other fishes and suck their blood, and also eat various kinds of animal matter.

GENERAL CONSIDERATIONS.

Fish as an article of diet is somewhat less nutritive than either meat or game, when taken weight for weight. An analysis of white fish shows it to contain 18 per cent. of proteid, 3 of fat, 1 of salts, and 78 of water; as against 27·5 of proteid, 15·5 of fat, 3 of salts, and 54 of water, in cooked meat. Most kinds of fish contain more water, therefore less nutriment, so that a greater bulk of fish must be eaten to represent the same proportion of other animal food. At the same time, fish is lighter, non-stimulating, and easier of digestion than meat or game, especially if taken without heating sauces or cooked with little butter or fat; and being much sooner digested, in one or two hours, according to firmness of the fibre, the stomach is more quickly ready for another meal. These facts—low proportion of nutriment, freedom from fat, laxity of fibre, non-stimulating character, and consequent rapid digestion—militate against fish as a source of proteid and energy for working men. It is nevertheless a valuable article of food, and is not sufficiently appreciated by many people, because it does not satisfy the appetite, like meat, and hunger sooner returns; but the health and vigour of fishermen and their families, and the inhabitants generally of fishing towns, prove it to be sufficiently nourishing for all practical purposes. From the nature and texture of fish, and its not requiring laborious work by the stomach, it is suited as a diet for those in early convalescence; but its low nutritive value is not

calculated to restore power in those debilitated by disease. Turbot, cod, whiting, haddock, flounder, brill, sole, plaice, are the least stimulating and the easiest digested, and consequently most suited for all invalids. Taking turbot as a type, the flakiness of the flesh and its opaque appearance after being cooked are indications of its freshness and goodness. When the fish is in its greatest perfection there is a layer of white curdy matter between the muscular flakes; on the other hand, a bluish, semi-transparent condition of the flesh after being cooked shows the fish is not in condition and should be rejected. Turbot is an excellent food, but may be rendered indigestible by the addition of lobster sauce. Whiting is well adapted for weak stomachs, on account of the laxity of its fibres; it is fairly nutritious and unstimulating. Haddock resembles it, but is of firmer texture. Sole and plaice are also tender, and yet sufficiently firm, but easy of digestion, and afford proper nutriment for persons of weak digestion. Cod has a denser fibre than any of the above, also more glutinous matter, and is an excellent food for the invalid and robust; on the whole, it is not so easy of digestion as the former, and it makes a division between the light kinds of fish and those heavier ones which are not suitable for invalids. Cod is generally preferred when large, but its flesh is then coarser. The heavier kinds of fish, as the salmon family, and mackerel, tunny, ling, mullet, halibut, and others, which are somewhat richer in nourishment, firmer, contain more oil, and require a longer digestion, are only suitable for persons in good health and with fair digestive powers. Some kinds of fish do not agree with every person—*e.g.*, mackerel, even when quite fresh, has been known to make persons exceedingly ill for a day or two.

The prevalence of leprosy in certain districts where fish is a common article of food has caused medical men of note to urge that the eating of fish in large quantities is the *fons et origo mali*; but others as stoutly urge that eating fish has nothing to do with it. The latter state that leprosy is an infectious or contagious disease spread amongst the people who have it by dirty habits and unhygienic surroundings. The inhabitants of the shores of Great Britain have always been large fish-eaters, and, whereas leprosy was once a common disease there, it is now, happily, unknown; nevertheless, it was never confined to the coasts,

whose inhabitants would naturally be the largest eaters of fish, as is proved by the remains of lazar or leper houses in the inland towns and country districts. The problem of the origin of leprosy, like many others, is a complicated one ; it is probable that the growth of the specific germ or bacillus is favoured by dirt and conditions of ill-health which still exist in Britain as elsewhere, although the disease has died out, and is rarely seen except in those who bring it from foreign countries, where the disease is still prevalent both in districts where fish is largely eaten and in others far from the coast where fish is almost unknown as an article of diet. Wherever there is an extensive coast, the inhabitants have always eaten largely of fish ; thus the Greeks esteemed it highly as a food, while the Romans had their favourite dishes, and the mullet was extravagantly prized by them. The inhabitants of Britain must always have had an abundance and have eaten largely of the best kinds ; and modern Britons, who delight in light, wholesome, nourishing food, have an abundance at their doors, some of which are highly valuable for their lightness, nutritiveness, and ease of digestion. It is the object and duty of medical men to impress these facts upon the public, in whose interests a freer use of fish is a point of importance.

THE MOLLUSCA : SHELL-FISHES.

(*a*) Lamellibranchiata.

Oysters (*Ostrea edulis*) and species are well-known eatable molluscs which live in shallow salt water, or at the mouth of rivers in a mixture of salt and fresh water. They are eatable at a year and a half old, and are in their prime at three years. Oysters are also cultivated in artificial beds, and these, called **natives**, are considered to be superior to those dredged from the natural beds. They contain about 22 per cent. of nutrients, including proteid 5 per cent., carbohydrate 15, and fat 1, as well as mineral salts, in a readily assimilable form, especially the coagulable albumins, glycogen, organic phosphorus, and a substance which on being heated develops what is called **osmazone**; a trace of copper appears to be always present, and they contain about the same amount of water as beef and mutton. They are considered delicious by many people, who eat them raw or cooked, but they are more easily digested in their raw state, as cooking coagulates

the albumin and makes them harder to digest than a boiled egg. They are taken along with stout and other beverages, which, however, are unnecessary. The best solvent, next to cold water, is diluted gin; Chablis and champagne are also good, but stout has no effect upon them. The connection of oysters with epidemics of typhoid fever indicates to us that extreme care should be exercised in the situation of artificial beds, so that there may be no chance of pollution by sewage; for, although it is known that oysters fatten upon sewage or something they extract from it, it cannot be disputed that several epidemics, attended by fatal results, have been caused by eating such oysters.

Mussels (*Mytilus edulis*); the common mussels, abundant around the coasts of Britain, in the Mediterranean and North Seas; largely used for food. Some people cannot safely eat mussels, as these molluscs irritate them and cause **urticaria**. The mussels are liable to be out of condition; they may not be fresh, or they may have been gathered from a ship's bottom; or there may be developed in them the ptomaine, **mytilo-toxin**, which, when consumed, will cause ptomaine-poisoning, with its unpleasant symptoms and consequences (*q.v.*). 'Musselling,' or mussel-poisoning, usually consists of sickness, vomiting, perhaps purging, and the appearance of urticaria or 'nettle-rash' upon the skin. The latter is an eruption of firm round patches or elongated wheals, which at first are pink, but soon become white in the centre; very rarely a blister appears upon the swelling, and the eruption is attended by intolerable itching. The proper remedy is an emetic and purgative to clear away the offending fish, and the free use of alkalies as a medicine and a lotion.

Cockles (*Cardium edule*) are common on sandy shores. They are used for food, and are of the same nutritive value as mussels. Like oysters, they have been associated with outbreaks of enteric fever, owing to similar contamination.

Clams (*Mya arenaria*), and several other bivalves, of which one is *Tridacna gigas*, a huge shell-fish, are nutritive, but not easily digested. Clams, however, make a highly nourishing and stimulating soup.

(*b*) **Gasteropoda.**

The Limpet (*Patella vulgata*), whelk (*Buccinum undatum*), and periwinkle (*Littorina littorea*), are all eaten for food. *Helix*

pomatia is the **Escargot** or snail so largely cultivated in France and elsewhere as food, and is highly esteemed by many people. Most of the Gasteropods are really nutritive, from the amount of albumin and phosphorus they contain.

CRUSTACEÆ.

Lobster (*Homarus vulgaris*), Norway lobster (Nethrops), sea crayfish (*Palinurus vulgaris*), fresh-water crayfish (*Astacus fluviatitis*), crab (*Cancer esculenta*), shrimp (*Crangon vulgaris*), prawns (Palæmon and Panalus). According to Payen, lobster contains 19 per cent. of proteid in the flesh and 12 per cent. in the interior. The others are all tasty morsels, relishes of no very high nutritive value, but often exceedingly useful as aids to the appetite. Caramote is a large shrimp caught in great numbers in the Mediterranean, and salted for exportation. Trepangs, or sea-cucumbers, which belong to the Echinodermata, are largely used in China and Eastern Asia for making soup.

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CHAPTER XI

SOUP, BEEF-TEA, JELLY

In making soup or broth the meat should be cut into small pieces and soaked for some time in the cold water which is to be used, a little salt being added to assist in dissolving the albumin. The meat and liquid are then slowly heated to about 150° F., at which temperature it is kept for a long time, finally boiling it for a few minutes to insure the destruction of bacteria, and using pressure to extract the fluid. Broth, the very best and most carefully prepared, never contains more than 6 per cent. of nourishment derived from the meat, or about 3 per cent. of dissolved and 3 per cent. of coagulated albumin, besides which the liquid contains salts and extractives (creatin, creatinin, inosinic and sarcolactic acids, etc.), which give it a flavour, and gelatine, which adds to its density. The nutritiousness of soup or broth can be greatly increased by the addition of farinaceous materials,

such as bean or pea flour, wheaten flour, oatmeal, semolina, rice, pearl barley, or vermicelli; while vegetables, as carrots, turnips, onions, celery, or others, add their juices, which are usually rich in salts valuable to the economy.*

There is a considerable waste of material in the preparation of beef-tea, mutton broth, chicken broth, and other meat infusions for sick persons, owing to the desire of presenting to the patient food of high nutritive value in small quantities. Beef-tea, for instance, is not the nutritious article it was once thought to be; indeed, it is almost the least nourishing of the foods usually given to the sick. Like broth, it only contains about 6 per cent. of nitrogenous matter from the meat, besides a little carbohydrate as glycogen and inosite; in fact, a pint of beef-tea only contains the nutriment of 1 ounce of beef. Patients are usually fastidious about their food, and desire that the beef-tea shall be *clear*. Clear beef-tea is just what they can be persuaded to take, but it is of little value to anybody as a food. However well and carefully prepared, there must be some 'grounds' at the bottom, consisting of coagulated albumin, and forming the principal part of the nutriment contained in it. The 'grounds' may cause the liquid to look muddy, which the patient objects to. Clear beef-tea contains almost nothing but the extractives, some salt, and water. The salts are always out of proportion to the albuminates, and the effect of drinking such a fluid is often an increased thirst, rise of temperature, and the certainty that an extra burden is thrown upon the system in the form of the **extractives** or waste nitrogenous materials which have to be excreted. According to *Germain Sée*, beef-tea contains little albumin and very little carbohydrate; the glycogen, inosite, and sarcolactic acid of the beef are altogether altered in the beef-tea, and most of the fat is removed. The nitrogenous materials, creatin, creatinin, carnin, and other quaternary products, to which the stimulating effects of beef-tea are due, are of low chemical composition, already on their way to form urea.

Hassall stated that a pint of beef-tea made from a pound of lean meat and hot water contained only 22 grains of nitrogen, whereas a pint of beef-tea made from a pound of lean meat infused in cold water contained 41 grains of nitrogen. He further

* *Consommée* is a soup or broth made by boiling meat and vegetables to a jelly.

showed that 14·5 pounds of beef would be required to yield enough beef-tea to supply the nitrogenous requirements of an individual doing an average day's work, calculating the waste nitrogenous matters excreted by the man as 512 grains of urea and 12 grains of uric acid.

Beef-tea, mutton broth, chicken broth, and other meat infusions, are useful for sick persons, for they are stimulating and restoring, and they are recognised now chiefly as stimulants to tissue change or to metabolism rather than foods proper. They do not prevent wasting of the body; indeed, when given alone, they cause more rapid wasting than no food at all. Dogs fed on beef-tea die sooner than when they are not fed at all. All meat essences and infusions, therefore, can only be regarded as temporary foods, for they are inadequate alone to maintain life; they should be combined with farinaceous materials to increase their nutritiveness, and must only be given alternately with milk and other foods. They are not only inefficient as foods for the sick, they are extravagant, being about the most costly articles of the dietary of an invalid, when we consider the low proportion of nutriment and the price of their purchase. The waste of meat in keeping up a daily supply of 1 to $1\frac{1}{2}$ pints (the usual amount) of beef-tea, mutton or chicken broth, is great. There are several excellent preparations of beef and mutton made by large firms, which the makers purport to yield to water a much larger proportion of the nutritious elements of meat than is contained in home-made beef-tea or broth. They, at any rate, have the decided advantage of being quickly prepared for the sick-room, which is a matter of great importance. Their freedom from fat is another recommendation.

There are many modes of making beef-tea, etc., but they differ little in point of nutrition, the main thing being the proportion of meat to water, and care in the application of heat. As regards proportion, beef-tea should have 1 pound of lean meat to 1 pint of water; mutton broth, 1 pound to $1\frac{1}{2}$ pints; and a chicken or rabbit will make 2 pints. It is of great importance to change the flavour of these liquids with each fresh supply. Onion, celery, bay-leaf, parsley, mint, thyme, ketchup, tomato, peppercorn, allspice, or other condiment, may be used in turn. Vegetables should be removed before serving it, and heavy vegetables, like turnips,

swedes, carrots, should never be used for invalids, as they contain an oil which is capable of upsetting the digestive organs.

A good method of making beef-tea is as follows: Let a pound of beef be freed from fat, beat it with a roller, and cut it into small pieces or tear it into shreds. Put the beef into a vessel with a pint of *cold water* and a teaspoonful of salt; allow it to stand for half an hour to extract the juices from the meat. Then put the whole into a double saucepan (or if that be not at hand, put it into a jar in a saucepan of water), cover it down, heat it gradually, and keep it simmering. The beef-tea must not boil, nor its temperature exceed 160° F., nor the saucepan boil dry. Occasionally separate the meat with two forks, as it has a tendency to become clotted together. If it is more convenient, the beef-tea can be made in a stone jar in the oven. The flavouring should be put in a few minutes before it is finished. When it is ready, pour the liquid off without straining it, and press out as much liquid as possible. The flocculent sediment contains a great portion of the nutriment, and must not be thrown away. The fat can be removed *en masse* when it is cold; but if some of the tea is required quickly, most of the fat can be removed by a piece of clean white blotting-paper.

Hassall's analysis shows that beef-tea made with cold water contains double the amount of nutriment in that made in the ordinary manner; and Liebig also favoured this method of preparation, for which he gave the following directions: Let the meat be cut very small, mix it with cold water and salt, digest it and agitate it frequently for an hour; finally, boil it for ten minutes, the flavouring being added; pour it off for use. Good beef-tea should not gelatinize, because the formation of a jelly shows that it has been boiled for a length of time, and the albumin has probably been all precipitated by the heat. Let the beef-tea be warmed up as required and served with a little dry toast. Patients who are not feverish may have a little of the meat finely minced or pounded like potted meat put in their beef-tea when given to them.

Beef-tea can be quickly made thus: Take 4 ounces of beef, *scrape it to pieces*, sprinkle a quarter of a teaspoonful of salt over it and a teacupful of cold water; allow it to stand ten minutes; then put it all into a saucepan over a fire, add a peppercorn, a

clove, or a little ketchup, and stir it constantly until the meat changes colour. Do not let it boil, only simmer it. It should be ready in fifteen minutes. Pour it off, and squeeze all you can out of the meat.

Beef essence is prepared thus: Cut a pound of beef into very small pieces, put it into a stew-jar, sprinkle some salt over it and two tablespoonfuls of water; cover it, and put it into an oven or a saucepan of boiling water. It requires two or three hours to draw out the juice, and five hours is not too long when no water is added to the meat. Care must be taken that it is not dried up. A small quantity of the liquid so prepared is added to water and given as ordinary beef-tea.

Raw-meat juice is prepared by scraping 2 ounces of lean beef, sprinkling it with salt, and adding two tablespoonfuls of water; let it stand ten minutes; express the liquid, flavour with ketchup or tomato sauce, and serve in a coloured glass, as its appearance is not very agreeable to a sick person.

Three methods of making beef-tea have been named above: (*a*) Infusing the meat in water kept below the coagulating-point of albumin; (*b*) applying such a degree of heat that the albumin is coagulated—that is, by making a decoction; (*c*) by simple maceration in cold water, no heat being applied. The advantage lies decidedly with the latter, as shown by Hassall and Liebig.

Several other carneous liquids are administered to sick persons as food—*e.g.*, **mutton broth**. This is best made by using the scrag end of the neck of mutton, and a few shanks may be added to give it additional gelatine. A pound of lean mutton is used to $1\frac{1}{2}$ pints of broth. Remove all fat from the meat and cut it into small pieces; put it into a saucepan with the water and some salt, a few peppercorns and a little allspice; cover with a lid, and simmer slowly for two hours. The scum must be removed as it rises, which the salt helps it to do. If it is not removed, it dissolves in the liquid and spoils the broth. After two hours add $\frac{1}{4}$ pint more water, with any other flavouring, and simmer for another hour. Strain, cool, remove fat, and warm up as desired. When required in a hurry, a little of the liquid can be taken out after an hour, cleared of fat by white blotting-paper, and flavoured with ketchup or tomato sauce. Plain mutton broth, made as above without flavouring except salt and peppercorns, is often

used, and after the removal of fat will agree with the most delicate stomach. It is, however, tasteless, insipid. Few people like it. There is usually no harm in adding an onion, carrot, or other pot-herbs, during the last hour of cooking, providing they are strained away for the invalid. Rice, pearl - barley, vermicelli, may be used instead of vegetables, and these, if well cooked, need not be removed, as the cereals add materially to the nutritive qualities of the broth, as also do pea flour and lentils. These, however, are flatulent, and should not be given to a person acutely ill.

Veal broth is made in the same way as the former. It is not very nourishing or stimulating, and, except when it contains much gelatine from the bones and ligaments and some flavouring, it is not very palatable. It can be made by boiling a knuckle of the shoulder or leg of veal, and the addition of the bones or a leg of a fowl or pheasant materially strengthens it and adds to its flavour.

The great *value of bones* in making broth or soup should not be overlooked, whether the preparation be for an invalid or healthy person. The nutriment from bones consists of the albuminous portion of marrow and other cells, of gelatine and fat, amounting in all to about 35 per cent. A most nourishing soup can therefore be made from them with the addition of very little meat. Bones, of course, require long cooking to extract their nutritious elements. They should be broken into small pieces, so that they may present as many surfaces as possible to the water, and the resulting soup is, when cold, a stiff gelatinous mass. When flavoured with vegetables or thickened with a little pea flour, wheat flour, or lentils, it is of a high nutritive quality. Care must be taken to strain the stock made from bones, so that all the little bits of bone are removed.

Cow's heel and **calf's foot** are credited with being very nutritious and strengthening. Their nutriment consists of the albuminous substance from the marrow, some fat, and a good deal of gelatine. The heel should be cleansed, crushed, and baked in the oven in a vessel containing a pint of milk and a pint of water for three or four hours, adding a little salt, pepper, onion, or celery, to flavour it.

Savoury pudding makes a change with other things for an invalid. Take three tablespoonfuls of bread-crumbs, a piece of

butter the size of an egg, the yolk of an egg, and a teacupful of beef-tea ; beat all together until thoroughly mixed. The white of the egg is now beaten to a froth and stirred lightly into the mixture. The whole is poured into a buttered dish and baked in an oven for six minutes. It is a nutritious and savoury dish, and makes a complete change from ordinary farinaceous puddings.

Stock for soup is made from all kinds of meat. Beef makes the best stock, because it contains extractives which give it a flavour. Mutton is apt to give it a tallowy smell far from agreeable, except when the meat has been previously roasted. Game and their remains give it a delicious flavour. So do old fowls and pigeons. Bones are valuable by enriching the soup in albumin and gelatine. The flesh and bony materials, in the proportion of a pound to a pint, are put in *cold water*, placed over a gentle fire, and heated gradually. The albuminous substances are dissolved by cold or tepid water and salt, but the use of boiling water at the beginning coagulates the albumin of the meat, and none can then be extracted ; consequently the broth or stock is thin and watery. Fat is dissolved from the meat and rises to the surface ; and a scum consisting of a little albumin and some impurities is formed, which must frequently be removed ; if it is not removed it dissolves in the liquid and makes it turbid. The bones are added last of all, and the whole simmered for five or six hours. When making the stock into soup, the required quantity is strained, and then boiled with the vegetables or other flavouring.

GELATINE : JELLY.

The public have great faith in jelly of every kind and name ; but, like beef-tea, it is of low nutritive value. Animals fed on jelly would die nearly as soon as if they were not fed at all. It cannot, therefore, be as nourishing as the public believe it to be. Some scientists say it is less easily assimilated than meat or fish. Jelly owes its gelatinizing power to **gelatine**, a substance which is derived from many tissues, such as skin, tendons, ligaments, and bone, by the aid of boiling water. The gelatine of shops is derived from such sources, and when dried in the air it forms translucent, nearly colourless sheets or shreds. One part dissolved in 50 parts of hot water solidifies to a jelly on cooling,

and is largely used for stiffening dietetic preparations. During digestion gelatine is converted into gelatine-peptone and absorbed. Jelly or gelatine is not despised by medical practitioners, for doubtless by its oxidation it spares the body from wasting to a slight degree. When acidulated or flavoured with wine or mixed with milk, jellies are suitable food for convalescents who need variety. Milk jelly is valuable as food to the extent of the milk it contains, and other jellies are nutritive in proportion as they contain alimentary substances in addition to gelatine.

Isinglass is a very pure form of gelatine, obtained from the swim-bladder of the sturgeon. It can be used in many ways for invalids. Its nutritive properties are the same as ordinary gelatine.

Pectin is a vegetable jelly found in many fruits and vegetables. It is capable of gelatinizing when boiled and cooled, as in black currant, raspberry, and apple jelly.

The following modes of preparation can be recommended:

Milk Jelly.—Take ¾ pint of milk; gelatine or isinglass, 1 ounce; gum arabic, 1 ounce; sugar-candy, 1 ounce; port wine, ¼ pint; and a little powder of cinnamon, nutmeg, or other flavouring. Mix all the ingredients together in a double saucepan or in a jar which can be placed in a saucepan of cold water; place over or near a fire, and stir the contents frequently until all are dissolved and mixed. Turn it into a mould to cool. It is stimulating and nourishing.

A simple milk jelly: Take a square of jelly sold at the shops, lemon, currant, or raspberry; dissolve it in a little boiling water, and add to it ¾ pint of warm milk; stir it well to mix it; pour into a mould to get cold and stiff.

Wine Jelly.—Take a bottle of port, claret, or other wine; ½ pint of water; 2 ounces of gelatine; four or five tablespoonfuls of lemon juice; ¼ pound of white sugar; two or three tablespoonfuls of fruit jelly; and the rind of one lemon or a piece of cinnamon for flavouring. Put the materials into a double saucepan over a fire, bring slowly to boiling-point, then withdraw the pan from the fire, and allow it to simmer for five minutes. *Strain* the mixture into a mould which has been just rinsed out with cold water. This is a stimulating and refreshing jelly, and somewhat nutritive.

Meat Jelly.—Take $\frac{3}{4}$ pound lean meat, eight shanks or knuckles of mutton, a piece of toasted bread, an onion or sweet-herbs or pepper, and salt to flavour. Let the knuckles be well cleaned, put them and the meat and vegetables into 2 quarts of water, and let them simmer for five or six hours; strain off the liquor, remove the fat when nearly cold, and pour into moulds to set. It may be eaten as a jelly or warmed to drink as soup.

Bread Jelly falls under the same category. It may be useful, and is very nutritious. Take two small milk rolls, cut them into slices, and toast them thoroughly dry; put the pieces into a basin with 2 ounces of sugar and a little nutmeg, cinnamon, or other flavouring; pour over them a pint of boiling water, cover, and set before a fire for half an hour; beat up, and pass through a sieve or piece of muslin into a mould; set aside to cool; serve with cream.

Blancmange is nutritive, and consists of cornflour and milk.

Cream sponges are soft, easily digested, and when not too rich are similar to jelly, but far more nutritious.

References: Halliburton's 'Chemical Physiology,' 597. Mays, *Philad. Med. News*, February 27, 1886. Jessop, the *Lancet*, 1888, i., 959. *Ibid.*, 1884, ii., 291. *Ibid.*, 1888, 136. *Brit. Med. Jour.*, 1894, ii., 1414.

CHAPTER XII

MILK, BUTTER, CHEESE

MILK.

Milk is one of the most important articles of food. Indeed, it is, or ought to be, the main food of every child under a year of age. It is a standard diet; that is, it is a representative of every class—the nitrogenous, by its casein and other albumins; carbohydrate, by its sugar; hydrocarbons, by its cream, besides salts and water. Milk is a secretion of the mammary glands of all animals belonging to the class of mammalia, and its natural object is to feed the young of its own species. There is nothing else in Nature exactly like it; but certain birds have a secretion comparable to it, and so is the juice of some plants. All milk is not alike. Thus the milk of woman does not contain so much of the important elements as cow's, and still less than goat's. Mare's and ass's milk resemble woman's more closely than cow's.

A table showing their composition is given in the chapter on Infant Feeding (*q.v.*). The following remarks will be principally confined to cow's milk, which is the liquid usually understood when the term 'milk' is used unqualified by the name of the animal from which it is derived.

The Composition of Milk.—The average of many analyses shows it to contain—proteids, 4 per cent.; fat, 4; sugar, 4·5; salts, 0·6; and water, 87. H. Droop Richmond[1] gives the following average of 30,000 samples of milk analysed in 1900: Water, 87·17 per cent.; fat, 4·07; sugar, 4·45; casein with salts, 3·33; albumin, 0·40; salts in solution, 0·73. Total solids not fat: Morning, 8·97; evening, 8·93. Total solids, including fat: Morning, 12·4; evening, 12·7. These substances are partly dissolved and partly in suspension in the water. The dissolved substances are sugar of milk, casein, peptones, lacto-chrome, salts, and minute proportions of other substances; and the suspended matters are milk fat and a portion of the casein in such fine granules as to be only arrested by filtering the liquid through earthenware. The appearance of milk through a microscope is that of a nearly colourless fluid containing innumerable globules. The number of globules depend upon the richness of milk in fat, varying from two to three and a half millions in a cubic millimetre.

The reaction of milk is peculiar. When tested immediately after being drawn from the cow it turns litmus red and turmeric brown, which is probably due to the acid phosphate of the alkalies which exist in milk. There is afterwards a constant development of carbonic acid, which gives a feeble acid reaction; but the milk soon becomes decidedly acid, with a tendency to an increase of this reaction from the development of lactic acid.[2]

The proteids of milk are casein-albumin, with smaller proportions of lact-albumin, nuclein or nucleo-proteid, and a peptone-like body. **Casein**, in its pure condition, is a perfectly white substance, somewhat transparent and brittle. It is insoluble in pure water, but soluble in dilute acids and alkalies. It is very similar to **alkali-albumin**, and is precipitated by rennet, by sulphate of magnesia, tannin, acids, gelatine, gum and sugar in excess, and many other things. Cow's milk contains 4 to 5 per cent.—never more. The other nitrogenous bodies in milk are lact-albumin, which is very much like serum-albumin in the

blood; a small proportion of lacto-protein and nuclein. **Nuclein** contains 9·6 per cent. of phosphorus, and is that substance in milk, eggs, liver, and other cellular bodies, which contains phosphorus in an organized condition. The albuminous substances of milk, *other than casein*, are coagulated by heat; and when milk is boiled they rise to the surface, and form a thin skin over it, which can easily be removed. After one layer is removed another will form if heat be still applied to the milk, and again for several times in succession, until all the coagulable albuminate is removed. People should not remove this *scum*, as they often consider it, for by so doing they remove an important part of the proteid constituents. Casein is not coagulable by heat; but it is readily precipitated by the rennin ferment of the stomach, and many other substances. **Rennin**, secreted by the glands of the stomach, is the ferment most used for this purpose. The infusion of a piece of calf's stomach (called **rennet**), as big as half a crown, will precipitate the albumin from enough milk to make 60 pounds of cheese, although the quantity of ferment cannot exceed a few grains. By the precipitation of casein, the milk is divided into curds and whey. **Whey** is the liquid which remains after the separation of the curds. It is a thin, almost transparent liquid, of a pleasant, sweetish taste. It contains a little proteid and fat, the milk-sugar, traces of urea, creatin, etc. Droop Richmond[3] gives the following analysis: Total solids—sugar, 4·45 per cent.; proteids, 1·24; ash, 0·52; CaO, 0·051; P_2O_5, 0·103. It is a nutritive drink, useful in the sick-room, but should not be considered in any sense equivalent to milk. It may cause flatulence and acidity in persons subject to these troubles. It is very useful in infant feeding as a diluent of cow's milk.

The fat of milk rises readily to the surface as cream when milk is allowed to stand undisturbed for a few hours. **Cream** is a yellowish-white, opaque liquid removed from milk by separation or skimming. Its colour is due to lacto-chrome. It contains the same constituents as milk, but the fat amounts to 47 or 48 per cent. The fat consists of small globules, each distinct and separate, surrounded by a hypothetical albuminous membrane. When cream is churned, these coverings are broken up, and the fat runs together to form a mass of butter. The membrane or pellicle surrounding these globules of fat is said by some

authorities to be albuminous or mucoid; by others, to be a layer of casein so thin as to be inestimable by weight; others, however, doubt the existence of any covering, but believe the oil is simply in a form of emulsion.[4] The fat consists of the triglycerides of stearic, palmitic, and oleic acids, with very small proportions of the glycerides of capric, caproic, caprylic, rutic, myristic, butyric, and valerianic acids, which give it the characteristic flavour. The milk of all herbivorous animals contains more fat than can be extracted from the fodder they eat.

The sugar of milk consists of **lactose**, which is peculiar to the milk of herbivorous animals, dogs, and women. Cow's milk contains an average of 4·5 per cent. Lactose is dissolved in the whey, and can be obtained from it. It is not sweet, like cane, beet, or maple sugar, but possesses similar nutritive properties. It is a fine, white powder, soluble in an equal quantity of boiling or seven times its bulk of cold water. It can be obtained from any chemist, and is recommended to be used instead of ordinary sugar for sweetening infants' food. It is powerfully diuretic, a property which is taken advantage of in the treatment of albuminuria and heart dropsy, for which purpose it can be taken in the form of whey or skimmed milk; or the powder (3½ ounces may be taken daily, dissolved in 2 quarts of water), taken at frequent intervals. It does not irritate or otherwise affect the kidneys.

The salts in milk are chiefly chloride and phosphate of soda, potash, lime, and magnesia. There is only a trace of iron, which is the greatest defect of milk when we consider it as a typical food.

The total solids of milk vary within considerable limits, for whatever influences the health and nutrition of the cow, as the character of its food, the length of time from eating, and other circumstances, modifies the quality of the milk. Certain cows also secrete more, others less, than the normal proportion of important constituents. The numerous analyses of Bell, Wanklyn, Blyth, Richmond, and others, show that the true lowest percentage of solids is 9 and the highest 12·7. Public authorities usually assert that the solids should be not less than 12 per cent., or 3·5 fat and 8·5 not fat.

Milk is adulterated by the addition of water or abstraction of cream; sometimes by the addition of glycerine to increase its specific gravity, or ordinary sugar to sweeten a watered milk, or by con-

densed milk and water; and by various preservative agents like boracic or salicylic acid or salt. New milk should not require the addition of a preservative agent, if it is carefully handled and rapidly distributed. Table cream may have 18 grains of boracic acid in a pound.

Condensed milk consists of the ordinary fluid which is concentrated by the evaporation of water, and mixed with ordinary cane-sugar. It is usually concentrated to one-third its bulk; therefore a pound of condensed milk can be made equal to 3 pounds of ordinary cow's milk, but it will be sweeter by reason of the added sugar. An analysis of a well-known brand gave the following composition: Water, 15·3 per cent.; fat, 8·85; albuminoids, 9·98; milk-sugar, 13·63; cane-sugar, 50·0; ash, 2·17; and solids which are not fat, 25·77 (O. Hehner). The statutory composition of condensed milk shows that it should contain not less than 28 per cent. of milk solids, of which one-fourth must be milk fat. Preservatives are unnecessary both for the sweetened and unsweetened brands, as they are sterilized and hermetically sealed. Various methods of preparation are known. In Campbell's[5] the milk is placed in a tank, which is heated by a hot-water jacket. Heated air is blown through the milk, by which means evaporation of water is induced until the liquid is of the consistence of condensed milk. Another manufacturer first removes the cream, then evaporates the milk to dryness, and reduces it to a fine powder. A quantity of cream in proportion equivalent to that removed is then thoroughly mixed with the powder, and it is again condensed at a temperature of 100° F. Both these methods are used in the preparation of unsweetened condensed milk.

The following table shows the composition of well-known brands of condensed milk:

	Water.	Fat.	Milk-sugar.	Cane-sugar.	Casein.	Soluble Albumin.	Ash.	Authority.
1. Unsweetened	63·47	10·22	13·94	—	9·81	0·49	2·07	Richmond
2. ,,	62·97	10·67	14·55	—	9·24	0·32	1·5	Faber
3. ,,	61·3	11·7	14·3	—	9·1	1·5	2·1	Goodfellow
1. Sweetened	25·48	11·52	12·89	38·57	9·43		1·93	Harrison
2. ,,	25·04	9·58	13·06	39·40	10·00		2·10	,,
3. ,, (skimmed)	25·97	0·75	14·07	44·72	10·99		2·39	,,

Powdered milk is an article of great utility in the preparation of food for infants and invalids, and can be used for those adults who from idiosyncrasy cannot retain ordinary milk. One special brand is a fine powder of a pale yellow colour obtained from skimmed milk by precipitation of casein with acetic acid, and afterwards neutralizing it with sodium bicarbonate. The dry residuum is said to contain 13 per cent. of nitrogen. Another method of preparing milk powder and desiccated milk is as follows: The milk is placed in a tank heated by a water-jacket; heated air is driven through the liquid until it is evaporated to the consistence of condensed milk; it is then transferred to a rolling drum, and more hot air driven through it until it is a semi-solid mass; the mass is then broken into lumps and pressed through a sieve to make it granular; the granules are afterwards dried and ground to a powder.[6]

Clotted Cream.—Ordinary cream has the same constituents as milk, but the fat is as much as 35 to 48 per cent. An analysis of Devon cream by Blyth[7] showed it to contain—milk fat, 65 per cent.; casein, 3·5; albumin, 0·5; peptones, 0·05; milk-sugar, 1·723; and water, 28·685. Richmond[8] gives the average composition as—milk fat, 58·2 per cent.; solids not fat, 8·60; ash, 0·71. It is generally of the consistence of a soft paste, and Devonshire cream is a good example; it is cream more or less condensed. The milk is kept in large pans at a gentle heat for many hours. By this means the cream rises rapidly, and with it a thin pellicle of albumin. Cream in any form is nutritive, and can be recommended for all delicate persons, especially for those of light weight or suffering from neuralgia and other nervous diseases. Those who are unable to take cod-liver oil are benefited by the free use of cream, which they may take with fruit, or in tea, or in any other way.

Koumiss.—The presence of sugar in milk enables it to undergo vinous fermentation. Koumiss is an alcoholic drink made by the fermentation of the milk of an animal. It is especially used by the nomad population of Tartary and the inhabitants of Russia, who make it from the milk of mares, asses, camels, or cows. It is very easily digested and absorbed, and is a useful food for invalids. Very little art is required in its preparation. To 10 parts of warm new milk, having some ordinary sugar added,

is mixed 1 part of sour milk.[9] The mixture is allowed to stand two or three hours, being stirred frequently. Sour milk contains the lactic ferment by which the sugar is converted into lactic acid, carbonic acid and alcohol also being produced in the process. Mare's milk contains more sugar than cow's, and therefore less ordinary sugar, if any, needs to be added. It is also made by fermenting cow's milk with yeast, as well as by the ordinary method. Various analyses show it to contain the same alimentary principles as milk, but that it is a very complex fluid. The composition given by Sharp[10] is as follows: Casein, 2·34 per. cent.; proteid, 0·8; including serum-albumin, 0·32; acid albumin, 0·22; globulin, 0·1; proteose, 0·16; acidity, 0·576, due to lactic, acetic, succinic, and other acids; fat, 1·943; sugar, 2·50; alcohol by weight, 1·06; urea, 0·017; carbonic acid, 0·61; ash, 0·21.

Butter-milk.—When butter is made, a thin fluid similar to whey is left behind. It contains all the constituents of milk, but a good deal of the sugar is turned to lactic acid, as in koumiss, and, of course, the proportion of fat is small, and the casein is not much below the normal. Blyth[11] found it to contain—water, 90·6 per cent.; casein, 3·8; fat, 1·28; milk-sugar, 3·38; ash, 0·9. It is an agreeable drink, feebly acid, very suitable as a beverage in cases of feverishness, and at all times for persons who are unable to drink milk in its ordinary condition. It is useful in feeding infants when mixed with milk, baked flour, oatmeal, or malted food and sugar, being of especial value in the summer-time, when the stools are sour and foul, in gastro-enteritis or other forms of intestinal disorder, for which the high acidity is beneficial. The casein forms very fine flocculi, which are very acceptable to the stomach.

The natural milk of one animal is not quite suitable for feeding the young of another species. It is true that milk is a typical food, containing all classes of alimentary substances; but the milk of one animal differs from another in composition, as seen by analyses given in the chapter on Infant Feeding. Nor is milk a perfect food. Although it contains the elements of a standard diet, an adult would have to drink 5 pints to obtain the energy required for a day, and double that amount would be required to supply sufficient carbohydrate for his daily use. This quantity would, however contain too much proteid or nitrogenous material,

as well as too much fat and water, and would thereby entail excessive work upon his digestive and excretory organs to deal with the surplus substances. Another great fault is the deficiency in iron, which is so necessary for the complete formation of our blood and the process of oxygenation. A prolonged course of milk diet, *no other food being taken*, is sometimes very useful in albuminuria, heart dropsy, and kidney disease. In these cases, however, **skimmed milk** only is taken ; and a portion of the casein can be removed, if it is desired, by the use of rennet. In this way the proportion of fat and casein is greatly diminished, and the other principles, being very easily assimilated, give little trouble to the kidneys. On the other hand, the lactose acts as a diuretic, and the water washes out the kidney tubules and promotes a healthy action.

Milk may be regarded as a solution of the elements of our food, excepting the fat, which is in the form of an emulsion. Its digestion begins with the precipitation of the casein in curds by **rennin**—a ferment secreted by glands in the mucosa of the stomach and contained in the gastric juice. The curds are then peptonized by **pepsin**—another ferment in gastric juice—and the resulting peptones, as well as the salts and water, are absorbed into the blood. The fat of milk is emulsified and saponified by the bile and pancreatic juices in the small intestines, and absorbed from that portion of the alimentary tract.

The curd of human milk, and that of mares and asses, is loose and flocculent, and easy of digestion and assimilation. But the curd of cow's milk is larger, heavier, and forms a much firmer mass, which is harder of digestion than the former. Many persons of weak digestion or peculiar idiosyncrasy cannot take cow's milk, or, if they do, it causes them pain, sickness, acidity, heartburn, flatulence, fulness, and other signs of indigestion. Persons who are over-heated by cycling, running, or other active exertion, should not drink pure milk, for people have died from acute gastritis in consequence of having taken a large draught, 1 or 2 pints, of milk while in that condition. Such a result is due to the curdling of the casein into firm, hard, or tough, cheese-like masses. It is well, therefore, to remember that the addition of barley-water, lime-water, or even soda-water, in equal parts, would prevent the casein from coagulating in such large masses,

the curd being looser and easier of digestion, and the thirst better quenched, by the dilution of the milk.

Boiling milk renders it more digestible. The curds formed in it are not so large and tough; they are softer and more readily penetrated and digested by the gastric juice. Opinions differ on this matter. Milk boils at 213·5° F., which is slightly higher than the temperature of boiling water. The lact-albumin is coagulated during boiling, and forms a film on the surface, which may be removed. The casein is slightly altered, some milk-sugar is converted to **caramel**, and a small amount of lactic acid produced.[12] But *prolonged* boiling, which is quite unnecessary for sterilization, causes the milk to be not so digestible as when raw. The casein is then less easily coagulated by rennet, and is more slowly digested by the gastric and pancreatic fluids.[13] It also causes a loss of lecithin, which is destroyed and diminished in proportion to the length of time it is heated;[14] and it is said to destroy the imperfectly understood vital principle which is in it, wherefore such milk is more likely to induce scurvy and rickets in infants than *raw* milk. But milk is an animal fluid in which bacteria breed with astonishing rapidity, and it ought never to be taken without previous sterilization. If it is just brought to a boil, or is boiled for one minute, the destruction of the germs of most infectious diseases is certain. For ordinary purposes, sterilization may be effected by raising it to a temperature of 155° F. for six minutes.

Milk is easily assimilated by most people. It affords a quick supply of nutriment to the system, which does not excite or stimulate the body like other animal substances. Its freedom from **purin** bases and other noxious principles renders it an exceedingly suitable diet, not only for infants, but for the aged, the delicate, and invalid, which can be used almost *ad libitum* in nearly every case of illness. Its nutritive value is enhanced by the addition to it of farinaceous materials like fine oatmeal, baked flour, arrowroot, and many prepared or patent foods.

Although Nature has provided us with this valuable compound fluid for our nutriment, wholesome and well designed for an alimentary material, yet, when its constituents are separated by art, they are not always so welcome to the stomach as Nature's mixture. Thus butter, from its oily nature, is apt to disagree

with some weak or irritable stomachs; and hot buttered toast, in which the butter is rendered empyreumatic by heat, may produce heartburn and other distressing symptoms. Cheese is nothing more nor less than the coagulum of milk, salted and partly dried. But it is one of the least digestible of our foods, and a bread and cheese meal is only suitable for a person who has a strong stomach, and is accustomed to a great amount of exercise. Toasted cheese is still more indigestible, from its acquiring a tenacity of texture hostile to the digestive functions of the stomach.

Milk, being an animal secretion, is an exceedingly favourable medium for the growth and development of the minute germs, bacteria and other fungi, which constantly float in the air, for which reason it is very liable to get contaminated by the germs of any disease which is prevalent. Boiling it will, however, destroy all disease germs except the *Bacillus anthracis*, and this nutritious article can be rendered safe and innocuous by this simple proceeding. It is never advisable to drink raw milk or use it for food: it should always be cooked, and no more should be boiled at one time than is likely to be soon used, for fear of recontamination.

Milk soon becomes sour, owing to the growth in it of *B. acidi paralactici*, *B. acidi lævolactici* — an aerogenic bacterium, and a micrococcus (Kozai), which live upon the sugar and produce alcohol, carbonic acid, and lactic acid, as in koumiss. As soon as sufficient acid is produced the milk separates into curds and whey. But the precipitation of casein in this manner is not the same as clotting by rennet; it is a downward process tending to disintegration and putrefaction. If it is left exposed to the air, another set of bacteria will grow in the fluid and produce butyric acid; and still others, which will set up putrefactive changes in the curd, while moulds and fungi of a different character will grow upon it.

Milk is often associated with the spread of disease in isolated cases or epidemics. From the readiness with which it absorbs vapours and gases, and harbours all sorts of microbes, it is evident that milk ought to be kept in a perfectly cool place, free from chance exposure to disease infection, from pollution by sewer gas, and all other sources of pollution. It is such a favourable medium for the growth of bacteria that chance

infection by the microbes of disease soon renders the milk a powerful source of contagion. Owing to this, many epidemics have been associated with the milk-supply. Thrush in infants is due to the fungus *Oïdium albicans* which grows in milk, and gastro-intestinal catarrh may be due to *aspergillus*, *penicillium*, and other fungi, growing in it. **Tuberculosis**, a disease of men and cattle, is transmissible from the cow to human beings by milk. This has been denied, and, seeing the important part which milk plays in our food from infancy to old age, it would be an excellent thing if the negative could be proved. But the bacilli of tuberculosis in cattle and human beings are practically the same. The bacilli of human tuberculosis will cause that disease in calves and other animals, and it is highly probable that milk is a prolific source of tubercular disease in mankind, and especially of the high rate of mortality from tubercular diseases in young children. **Scarlet fever** epidemics have been sometimes traced to the milk-supply. In some cases the origin of the epidemic was due to the cows having been milked by a person suffering from a mild attack of the disease, or to the milker nursing someone who was ill with it, or to the milk having been stored in an infected house. Cows are also liable to a disease very closely resembling scarlet fever, and their milk has been the cause of epidemics of the disease among the consumers. **Diphtheria** has likewise been epidemic from a similar cause. The connection of **enteric fever** with the milk-supply is also very close, and its origin has been traced to the washing of milk-cans with water polluted by the dejecta of fever patients, or the intentional dilution of the milk with such water. Some outbreaks of enteric have been associated with the absorption of sewer gas by storing the milk in a dairy having a faulty drain.

Invalid Preparations of Milk.—Milk is at all times an important article in the sick-room, and there are few patients who are unable to take it in some form—milk, milk and raw egg, junket, custard, milk jelly, milk puddings, arrowroot or cornflour and milk, blancmange, oatmeal gruel, other farinaceous foods and casein preparations containing dried milk, besides whey and butter-milk, are only a few of the ways of administering it. It is not out of place to again remind the reader that lime-water, barley-water, and similar articles, are means of checking the

formation of large and hard curds in the stomach, and will prevent pain and vomiting in many persons who cannot take milk alone, and that the addition of farinaceous foods, arrowroot, cornflour, or fine oatmeal, have a similar effect. Some of the patent foods have a direct influence over the casein; when mixed with warm milk or water the natural digestive principle in the food becomes active, and the casein of the milk is so modified that firm, indigestible curds cannot form in the stomach. In the preparation of junket likewise the casein is coagulated before it is consumed, and can be beaten up into very fine particles, which cannot injure the stomach.

Junket consists of the casein of milk which has been coagulated by the addition of a curdling agent. Boiling the milk with a little vinegar or acetic acid will precipitate it, but such a coagulum is not the same as that prepared by Nature's method. A junket can be prepared by putting a piece of rennet or calf's stomach into a dish of warm milk; after a few minutes it will begin to coagulate into a homogeneous, jelly-like curd, which gradually separates from the whey; the curd is whipped up with the whey, and then allowed to rest; in an hour or two the whole forms a jelly which is soft and flocculent, easy of digestion, adapted to the stomach of invalids and those who, by idiosyncrasy, are unable to take milk in any other way. Various essences prepared from rennet are kept in stock by chemists, and are handy for use. The following recipes indicate their use:

(*a*) Take 1 pint of milk, a little nutmeg or cinnamon, half a wineglassful of brandy, and a dessertspoonful of sugar. Warm the milk, sugar, and brandy to blood heat (100° F., not more), pour it into a dish, and add a tablespoonful of prepared rennet, or a teaspoonful of essence of rennet; stir together. When cold it will be a jelly; sprinkle upon it a little nutmeg or cinnamon.

(*b*) *Cocoa-junket.*—Mix an even tablespoonful of cocoa and two teaspoonfuls of sugar with two tablespoonfuls of boiling water to a smooth paste; stir in thoroughly ½ pint of cool, fresh milk; put it into a saucepan and warm it to blood heat; add a teaspoonful of pepsencia, and stir it just enough to mix it. Pour it into a vessel to set; it is ready when cool, and may be eaten alone, or with ice, bread-and-butter, cake, or a cracker.

Peptonized Milk and Milk Foods.—The artificial digestion of

food is a matter of great importance in many cases of illness, especially in acute gastric catarrh, pyloric and intestinal obstruction, crises of cardiac and renal disease, uræmic vomiting, pernicious anæmia, enteric, scarlet, diphtheria, and other fevers or diseases; and also for nutrient enemata in the same cases. In gastric catarrh, such as follows alcoholic excess, when the stomach rejects beef-tea or diluted milk in the smallest quantity, peptonized milk or milk gruel will often stay down, and assist in allaying the vomiting and feeling of distension. In gastric ulcer, when abstinence from food is not altogether indicated, peptonized milk or fine oatmeal gruel is a great advantage, giving the stomach that absolute rest which it needs, and preventing severe abdominal pain and vomiting; its use may be continued for weeks, during which the strength will recover and the weight increase. In heart disease, such as valvular incompetence or dilatation with overfull veins, in congestion of the liver or kidneys with dropsy, the administration of peptonized food in small quantities frequently repeated, even when no solid food will keep down, often gives the most gratifying results. In pernicious anæmia of comparatively recent origin, when the stomach is very irritable, peptonized milk gruel is tolerated, and may be used to the amelioration, and sometimes complete restoration, of the patient.

Peptonized foods are made with the ferments obtained from the stomach and pancreas *extra corpus*; by these preparations we can change the casein of milk into peptone ready for absorption without materially altering the flavour and appearance of the milk—a matter of prime importance in feeding the sick. In the same manner peptonized gruel or beef-tea can be prepared. Several firms make preparations of these ferments; they are readily available, easy of application, and are often used in cases where peptonized foods seem the only alimentary materials at command capable of absorption.

Boiled Peptonized Milk.—Put a peptonizing powder into a clean enamelled saucepan with a small teacupful of cold water; stir it well; then add to it 1 pint of cold fresh milk. Heat it to boiling-point, constantly stirring the while. The heat should be so applied that the whole comes to a boil in ten minutes; it is then ready. Milk so prepared will not become bitter. Allow it to

cool; pour it into a clean bottle and cork it tightly, and keep it in a cool place. When it is needed for use, pour out only the portion required, and cork it again.

Cold or just warm milk may be peptonized thus: Put two tablespoonfuls of cold water into a tumbler, dissolve in it a peptonizing powder, then add a teacupful of cold or warm milk; stir the mixture thoroughly, and it is ready; it should be drunk immediately, sipping slowly.

Peptonized Milk Gruel.—Put into a soup-plate $\frac{1}{2}$ pint of thick, well-cooked *hot gruel*, and $\frac{1}{2}$ pint of fresh *cold* milk; add the peptonizing powder or liquid; stir it well, and it is ready for use. It is to be drunk immediately, sipping slowly. The *gruel* may be made from any farinaceous material—fine oatmeal, barley-meal, baked wheaten flour, cornflour, arrowroot, etc. In each instance the material must be thoroughly cooked in water until the starch granules have been swollen, broken up, and incorporated with the water into a paste; arrowroot requires but a few minutes, oatmeal several hours, for this purpose. Peptonized milk gruel has a more agreeable taste than peptonized milk alone, and affords more nutriment to the patient.

Peptonized Milk Jelly.—Prepare 1 pint of peptonized boiled milk, and dissolve in it a $\frac{1}{4}$ pound of white castor-sugar. Prepare likewise $\frac{3}{4}$ ounce of pure gelatine by dissolving it in a teacupful of boiling water; add to it the juice of a lemon and of an orange, and three or four tablespoonfuls of brandy or rum; strain this mixture. When the peptonized boiled milk is sufficiently cool or only just warm, mix the two solutions together; pour into a mould, and set aside to get cold and firm. Any other flavouring can be used to vary it; the only precautions necessary are to boil the milk after peptonizing it in order to destroy the ferment, otherwise it will digest the gelatine and the jelly will not set; the other is to mix the solutions when the milk is only just warm.

Peptonized milk punch is superior to that prepared with ordinary milk, because the spirit will not curdle peptonized milk, nor will lemon juice or acid phosphate, which can be freely used. It is prepared in the ordinary way, only the milk is peptonized and boiled previously; it is very agreeable, and its great value is apparent when both nutrition and stimulation are required; it

is superior to koumiss or milk fermented with yeast, for in those articles the casein is not digested at all.

Peptonized Beef-tea.—It is advisable to include peptonized beef-tea here to complete a series. Take $\frac{1}{4}$ pound of raw lean beef free from fat, or the same weight of beef and chicken in equal proportions, or of chicken alone ; let it be minced very finely ; add to it $\frac{1}{2}$ pint of cold water, put it into an enamelled or other clean saucepan, cook it over a gentle fire, stirring constantly until it has boiled a few minutes. Pour off the liquor, and preserve it ; beat the meat into a paste, and put it into a bottle with $\frac{1}{2}$ pint of cold water and the liquor poured from the meat. Add to it a peptonizing powder, and shake it up well ; set it aside in a warm place of about 110° or 115° F. for three hours, shaking it occasionally ; then boil it quickly to destroy the ferment. It can now be clarified by the addition of the white of an egg and strained, and a little seasoning added according to taste. It is not *necessary*, however, to strain the beef-tea, but it is more agreeable to the eye ; on the contrary, the portions of meat which remain undissolved will add to its nutritiveness, and be so acted upon by the ferment that it will be very soft and diffused through the liquid in fine particles, almost impalpable, and fit for rapid digestion and absorption in the stomach. Farinaceous materials may be used in the preparation of peptonized beef-tea or chicken broth by simply boiling a sufficient quantity of flour or arrowroot or fine oatmeal in half the second quantity of water prescribed for this preparation, and mixing the two fluids together before adding the peptonizing powder, so that the meat and gruel will be peptonized at the same time ; it has a more agreeable flavour than peptonized meat broth alone. Fluids are sold prepared by the peptonization of lean beef and wheaten flour together, and afterwards concentrated and preserved in sherry ; they are an excellent food for invalids and in cases of acute illness or during convalescence.

Peptonized Milk and Farinaceous Food for Infants.—In the artificial feeding of infants we often meet with difficulty owing to indigestion, in which hard, indigestible curds of milk are formed in the stomach and soon vomited, or passed into the intestine, where they cause, pain, diarrhœa, or intestinal catarrh. These cases are most often met with in warm weather. Very

often they improve vastly by feeding them with peptonized milk or milk gruel; in many cases the results are surprising. It may even be given to infants a few days old until proper digestion is established. It is not intended hereby to recommend the wholesale use of peptonizing agents in the preparation of infants' food; for it is believed that the digestive organs ought to do their own work, and that substituted digestion should only be a temporary measure in any case. There are, however, many infants of a few weeks or months old who are unable to digest milk for quite a long period; in such cases it is essential that the gastric organs should be assisted in their functions, or actually allowed to rest from work, excepting absorption and excretion. Peptonizing powders and peptogenic milk powders are sold for this purpose. It is better to prepare each supply of milk as it is required for use; and the powder should be added to the water with which the milk is to be diluted, thus: Dissolve the powder in a gill of water, and mix it with a gill of fresh milk; keep it warm for half an hour before feeding. The length of time the ferment is allowed to act depends, however, on the necessity of the case. By this method we get rid of the curd, which is converted into absorbable and nutritious food, before feeding. When children are at an age to require farinaceous food, peptonized milk gruel made of fine oatmeal, wheaten flour, or arrowroot, is suitable for those whose stomachs are unable to retain or digest ordinary food.[15]

BUTTER.

Butter consists of the fat of milk, derived from cream by violent agitation in a churn or other butter-making machine until the fat accumulates in a mass, with some casein and whey. Butter-milk is the thin fluid which is left behind when the fat has been extracted. Its composition has been given. Butter consists of about 85 per cent. of fat, the rest being casein, sugar, salt, and water. Some salt is added in the manufacture to give flavour and assist in preserving it. Butter is beaten and pressed into shape for sale, during which process some of the butter-milk escapes. It is a solid substance at ordinary temperatures, with an agreeable taste, characteristic odour, and a pale yellow colour. The fat consists of a mixture of olein, palmitin, and

stearin, which are insoluble in water, and in such proportions as to remain solid at ordinary temperatures. It also contains several volatile fatty acids, which give the characteristic flavour and odour. The fatty acids from 100 grammes of butter obtained by Hehner and Mitchell[16] were: Stearic, 1·83 per cent.; di-stearic, 1·0; oleic, 32·5; palmitic, 38·5; myristic, 8·89; lauric, 2·57; capric, 0·32; caprylic, 0·49; caproic, 2·09; butyric, 5·45—total, 94·5.

Pure, dry milk fat has a melting-point of 35·8° C.—a little below blood heat—at which its specific gravity is 0·914. Olein, which comprises 40 per cent. of it, is fluid at ordinary temperatures, but solidifies at 5° C., is without colour, taste, or smell, but becomes yellow after exposure to the air from absorption of oxygen. Palmitin and stearin are both solid white fats, which together comprise about 45 to 50 per cent. Stearin is a hard, heavy fat, with a high melting-point (35° C.), and is found in nearly all animal and a few vegetable oils.

MARGARINE, OLEO-MARGARINE, BUTTERINE.

A mixture of stearin and palmitin together crystallizes in needle-like tufts, and was once thought to be a definite separate fat called **margarine**. **Butterine**, or margarine of commerce, however, contains other substances—*e.g.*, coco-nut oil. It is chiefly manufactured from **beef fat**, and when properly prepared its composition resembles that of butter; but the free volatile fatty acids which give to butter its flavour and aroma are deficient, and it is artificially coloured. Wynter Blyth gives the following percentage composition: Palmitin, 18·31 per cent.; stearin, 38·50; olein, 24·95; butyrin, caproin, and caprylin together only 0·25; casein, 0·74; salts, 5·23: water, 12·01.

It can be made from mutton fat also, but the product contains more stearin, and is harder and not so well flavoured. The manufacture of margarine is an important industry on the Continent of Europe and in the United States. It is often used to adulterate butter, and is occasionally sold as the genuine article.

CHEESE.

Cheese is made by the precipitation by rennet of the casein and cream of milk as curd. It may be made from the milk of any animal, but fresh cow's milk is chiefly used. The precipitate contains most of the casein and fat, besides some milk-sugar, common salt, alkaline and earthy phosphates. The whey or liquid is strained off, the curd is pressed into shape in moulds, and the cheeses are frequently turned over at definite periods, so that the whey drains away, and the moisture is evenly distributed and gradually evaporated, until the interior is of proper consistence and the exterior has the usual firm and dry rind.

Cheese undergoes a transformation in *the ripening*, by which it acquires an agreeable taste and flavour ; this is a gradual process of fermentation due to the action of moulds and bacteria. Russell and Babcock claim that the ripening of cheese is due mainly to normal enzymes ; but Bockhoet and Otto de Vries show that it is difficult to get a cheese to ripen without the presence of bacteria. When cheese is made from milk under perfect aseptic conditions during collecting and cheese-making, only a few bacteria gain admission to it, and ripening does not occur. Such milk contains all the natural enzymes, and differs only from other milk in the absence of bacteria; these observers, therefore, conclude that the ripening of cheese is due to bacteria. During this process a good cheese gets richer in fat, various aromatic bodies and extractives are developed, and there is a constant loss of water, and in some cases slight decomposition of fat. Fresh cheese has an acid reaction, but in a ripened cheese the reaction is alkaline, owing to the generation of a small proportion of ammonia, which, together with free fatty acids and lactic acid, varies as the ripening process goes on, the nitrogenous material undergoing changes by which the smell and taste are developed.

The moulds in cheese are innocent enough, and so are the aromatic bodies; but in advanced decay of cheese a poisonous ptomaine (**tyrotoxicon**) is produced, which is capable of causing very serious results, allied to those of atropine-poisoning. Cheese has been adulterated by a species of artificial cheese, in which the natural fat is replaced by a substance like margarine. Various

mineral substances have likewise been added to give it weight and colour, and from early times vegetable colouring matters, which are probably not injurious, have been used in its manufacture ; but the red colour is sometimes due to the *Micrococcus rubricasei* (Otto Gratz).

Cheeses are hard or soft, according to the pressure and temperature used in making them.

Soft cheeses are made by precipitating the curd at a low temperature, and using very little pressure in the after-treatment. Good examples are: English **cream cheese**, which contains 50 to 70 per cent. of fat and only 2 or 3 per cent. of casein. **Neufchâtel**, which has 41 per cent. of fat and 17·5 per cent. of casein. **Rocquefort** is a somewhat peculiar example of the soft cheese; it is prepared from the milk of ewes. When new it contains 85·5 per cent. of casein and only 2 or 3 per cent. of fat; but a great change takes place in it during ripening, for which purpose it is stored for seven or eight weeks in cold cellars or mountainous caves cooled by currents of air. A good ripe cheese contains as much as 32 per cent. of fat, and only about 43 per cent. of casein[17]—a forcible example of the production of fat from proteid substances.

Hard cheeses are made of curds produced at a higher temperature, and subjected to much greater pressure in the after-treatment. There are many examples. Genuine **Stilton** is made from new milk, with additional cream. A good, ripe example contains 20 to 35 per cent. of casein, and 42 to 45 per cent. of fat, and is similar to Rocquefort. Inferior cheeses of this class have crept into the market, made of milk only, or of milk deficient in cream. **Cheddar** is made of entire milk, and contains 27 per cent. or more of casein and 25 per cent. of fat. **Gloucester**, of new milk and skimmed milk together, or of skimmed milk only, contains 25 to 28 per cent. of fat and 28 to 31 per cent. of casein. **American** is made of entire milk, and contains—casein, 20 to 36·5 per cent. ; fat, 20 to 33·5 per cent. **Gorgonzola** is an excellent cheese, containing about 26 per cent. of fat and a similar amount of casein. **Parmesan** is a very dry cheese, having only 6 to 15 per cent. of fat and 25 to 40 per cent. of casein.

The composition of various cheeses analyzed by W. Chattaway, T. H. Pearmain, and C. G. Moor, is as follows :[18]

Name.	Water.	Ash.	Fat.	Reichart, C.C. $\frac{N}{10}$.	Nitrogen.	Casein.	Valenta Test.
English cheddar	33·8	4·1	30·5	26·4	4·20	26·7	31·0
Canadian ,,	33·3	3·6	30·6	24·0	4·34	27·6	41·5
American ...	29·8	2·7	33·9	26·2	4·76	20·3	47·5
,, ...	30·6	3·6	27·7	3·0	4·84	30·8	82·0
Gorgonzola ...	40·3	5·3	26·1	22·1	4·36	27·7	26·5
,, ...	33·9	4·6	26·7	23·6	4·06	25·8	45·0
Dutch	41·8	6·3	10·6	27·0	5·11	32·5	40·0
,, ...	37·6	6·5	22·5	23·0	4·58	29·1	49·0
Gruyère	28·2	4·7	28·6	30·0	4·93	31·3	37·5
,, ...	35·7	3·7	31·8	31·1	4·49	28·7	41·0
Stilton	19·4	2·6	42·2	29·0	4·73	21·1	38·5
,, ...	21·2	2·9	45·8	32·0	4·14	36·3	45·5
Cheshire... ...	37·8	4·2	31·3	31·6	4·03	25·7	43·0
,, ...	31·6	4·4	35·3	31·8	4·16	26·5	47·0
Double Gloucester	33·1	5·0	23·5	31·4	4·99	31·8	38·0
,, ,,	37·4	4·6	28·1	32·3	4·5	28·3	41·0
Camembert ...	47·9	4·7	41·9	31·0	3·43	21·8	32·0
,, ...	43·4	3·8	22·6	35·0	3·83	24·4	33·0
Parmesan ...	32·5	6·2	17·1	28·0	6·86	43·6	28·0
Rocquefort ...	29·6	6·7	30·3	36·8	[illegible]	28·3	19·0
Double cream ...	57·6	3·4	39·3	31·3	3·14	19·0	40·0
Bondon	39·5	0·7	24·4	29·4	1·48	9·4	42·0
York, cream ...	63·1	1·4	6·5	29·0	2·76	17·9	41·0
Cheddar, average	33·5	4·0	29·0	25·9	4·3	27·4	—
American ,,	27·5	4·5	30·4	—	4·6	29·7	—

Cheese is in many respects a very valuable food, rich in flesh-forming and energy-producing material; indeed, it is so rich in nitrogen and fat that a meal of bread and cheese supplies the needs of the system as well as an elaborate meal of meat and the usual accompaniments. A comparison of the digestibility of meat and cheese is, however, very much against the latter. There are many people who cannot digest cheese at all. Amongst other consequences, it is often followed by an attack of dyspepsia, and a supper of bread and cheese is accountable for many evil dreams. It is a good diet for people who lead a very active life and spend much of their time in the open air, for those who have healthy organs, and especially a good stomach. With other individuals, particularly those of a sedentary habit, a small piece of cheese at the end of a meal acts as a stimulant to the digestive organs, calling forth the muscular activity of the stomach and provoking a flow of gastric juice, to which extent it is an aid to digestion, similar to mustard or any other condiment. To people who have

a weak stomach or any chronic disorder thereof, cheese is as great an enemy as other indigestible articles, and should be avoided by them, just as they avoid liver, kidney, tough meat, pastry, pickles, or other article which experience has taught them to be injurious.

REFERENCES: [1] The *Analyst*, xxvi., 309. [2] Wynter Blyth's 'Manual on Foods.' [3] The *Analyst*, 1893, xviii., 52. [4] *Ibid.*, xxii. [5] *Jour. State Med.*, April, May, and July, 1902. [6] *Ibid.*, April, 1902. [7] Blyth, *loc cit.* [8] The *Analyst*, xxi., 89. [9] Blyth, *loc. cit.* [10] Sharp, *Pharm. Jour.*, 3rd series, xxiii., 513. [11] Blyth, *loc. cit.* [12] Wroblewski, *Oest. Chem. Zeit.*, i., 5. [13] Leeds and Blackader, *Am. Jour. Pharm.*, September, 1901. [14] Bordes (*Ann. de Chim. Anal.*, 1903), the *Analyst*, 1903, 214. [15] Burroughs Wellcome and Co.'s 'Recipes for Peptonising Foods.' [16] 'Butter-fat,' Hehner and Mitchell, *Jour. Chem. Soc. Abstracts*, 1899, 55. [17] Blyth, *loc. cit.* [18] The *Analyst*, July, 1894, 146.

CHAPTER XIII

VEGETABLE FOODS

THE vegetable kingdom affords a vast number of members from which we may derive nutriment. Many of the proximate chemical and physiological principles composing the substance of vegetable tissues are isomeric with similar principles in animal tissues, and they are in such a form as to be readily assimilable by the human organism. A comparison of the chemical elements in the vegetable substances and those in the human body also shows them to be nearly the same. Thus, all plants contain carbon, derived from the air by the aid of chlorophyll; hydrogen, absorbed in the form of water, ammonia, and other compounds; oxygen, in combination as carbonic acid, water, and many salts; nitrogen, in the proteids and salts, taken up by plants chiefly in the form of nitrates and compounds of ammonia; sulphur, a constituent of the proteids and other tissues, is derived from the sulphates in the soil; phosphorus, mainly in the proteids, but also in seeds and other vegetable tissues, is obtained from the phosphates in the soil. Iron, in the green parts of plants and seeds, is absorbed as a salt from the soil, and is absolutely necessary for the formation of chlorophyll. This has been denied by some authorities, but others as strenuously assert it. At any rate, leaves produced by plants which are not supplied with iron, as when seeds are grown

in water, become white or chlorotic as soon as their store of this element is exhausted, but recover their colour if a minute proportion of an iron salt is dissolved in the water, thereby showing the important part played by iron in plant life. Potassium salts derived from the soil are abundant in all parts of plants which are rich in carbohydrate, such as sugar or starch; also in the green parts of plants. They are necessary for the due performance of vegetable metabolism, for in their absence the absorption of carbonic acid and utilization of carbon by plants containing chlorophyll is not properly carried out. Sodium is found abundantly in all plants. Calcium and magnesium salts are also important constituents necessary for the normal growth of plants. They are absorbed from the soil as nitrates, phosphates, and sulphates. Silicon exists in the cell walls and various fibrous tissues, being taken up from the soil as silica. Though of no great nutritive value, a small proportion of the latter is useful in the economy of both plants and animals. Iodine and bromine occur in marine plants; lithium in tobacco; zinc, copper, and boron in other plants in small but appreciable quantities.

The inorganic substances of plants consist chiefly of chlorides, sulphates, and carbonates, of potash, soda, lime, magnesia, silicon, and iron. As an example of the proportion of such inorganic constituents, the following table, quoted from Vine's 'Botany,'[1] shows the amount in 1,000 parts of dry, solid matter in wheat, potatoes, apples, and peas:

	Total Ashes.	Potash.	Soda.	Lime.	Magnesia.	Ferric Oxide.	Phosphoric Acid.	Sulphuric Acid.	Silica.	Chlorine.
Wheat grain ...	19·7	6·14	0·44	0·66	2·36	0·26	9·26	0·07	0·42	0·04
Potato tubers...	37·7	22·76	0·99	0·97	1·77	0·45	6·53	2·45	0·80	1·17
Apples ...	14·4	5·14	3·76	0·59	1·26	0·20	1·96	0·88	0·62	—
Peas (seeds) ...	27·3	11·41	0·26	1·36	2·17	0·16	9·95	0·95	0·24	0·42

The Organic Constituents.—Plants, like animals, are made up of cells, which have a cell wall and contents. The cell walls consist of **cellulose**, $C_6H_{10}O_5$, a carbohydrate. The outer layers may be transformed into **cutin**, a substance only slightly permeable by water; or **lignin**, which forms a hard, inelastic coat to the cells,

but is nevertheless permeable; or to a **mucilaginous** substance, which is hard and horny when it is dry, but swells by absorption of much water when it is exposed to wet, as in linseed and quince-seed; or into **gum**, which is soluble in water.

The cell contents are living and not-living substances. Cells which compose the succulent parts of plants, as the leaves, fruit, and seeds, or tissues and stems—that is, the bulk of the actually living tissues—contain a large amount of living protoplasm, which is a substance of a viscid, tenacious character and proteid nature. It fills the cells, but contains spaces or vacuoles for the cell sap, the nucleus, and various other particles of differentiated protoplasm called the plastids.

The **plastids** consist chemically of proteids so differentiated as to form two distinct bodies. One of these, called the **leucoplastid**, is colourless, and its function is to manufacture starch for the use of the plant; the other, containing the chlorophyll colouring matter, is called the **chloroplastid**, and forms starch grains also, but it assists in the general process of assimilation and metabolism by constructing organic substances under the influence of light from carbonic acid and water.

The non-protoplasmic or not-living contents of the cells consist of the sap and certain formed bodies, the most important of which are starch grains, proteid granules, sugars, fats, oils, salts and water, which are such important elements in our food as to need further consideration. They fall into two classes, nitrogenous and non-nitrogenous.

1. The nitrogenous or proteid substances in plants consist of a molecule of a complex chemical constitution to which no definite formula has been given. They are generally of a viscid nature, like the white of an egg, and usually indiffusible. Some are soluble and others insoluble. Thus, the **albuminates**, such as gluten of wheat, are insoluble in water and solutions of neutral salts, but are soluble in alcohol and dilute acids or alkalies. **Globulins**, which enter largely into the formation of aleuron grains, are insoluble in water or solutions of neutral salts (as chloride of sodium), but are coagulable on boiling, and sometimes crystallizable. **Albumin**, soluble in water and coagulable on boiling, rarely occurs; but **albumoses** are a common constituent of aleuron: they are soluble in water, not coagulated by boiling,

but are precipitated by acids. **Peptones** occur in germinating seeds. With these albuminoids phosphorus is a constant accompaniment, owing to the presence of nuclein and lecithin. Vegetable globulins are regarded as compounds of acid albumin with a saline basic salt, which, on being freed from the base, splits into casein and hetero-albumose. Many other vegetable albumins are likewise regarded as compounds of acid albumin with saline bases, which form casein when freed from the salt. The inorganic salts, therefore, play an important part in the elaboration of albuminoids.

Aleuron grains are granules of proteid matter of various sizes, and oval or spherical in form. They are somewhat larger than starch grains, and, although they usually have no structure such as the latter presents, are sometimes crystalloid. Aleuron is a mixture of proteid substances consisting of a homologous series, beginning with hetero-albumose, and passing through globulins into albumins. It occurs abundantly in seeds, usually in the vacuoles of the cell protoplasm. Each particle has a nucleus, consisting of a crystal of double phosphate of lime or magnesia, about which the proteid substances are deposited.[2] Other proteid crystalloids sometimes occur in the tubers of potatoes and leaves of plants—*e.g.*, **vitellin**, a kind of globulin.

2. Amides, or amido-acids, are a class of nitrogenous bodies occurring in plants and seeds—*e.g.*, asparagin, leucin, and tyrosin —which are soluble in water, diffusible and crystallizable, but are not coagulated by boiling.

3. Various alkaloids of a nitrogenous character occur, as theine in tea, caffeine in coffee, theobromine in cocoa, atropine in belladonna, morphine in opium.

4. Enzymes having the power of digesting fleshy substances are secreted by some of the higher plants, as pineapple and papaw.

The non-nitrogenous substances in the cell contents are as follows :[3]

1. The **Carbohydrates** include the amyloses, saccharoses, and glucoses. The amyloses ($C_6H_{10}O_5$) are :

Starch, especially abundant in seeds, tubers, roots, rhizomes, and other parts of plants, where it serves as a reserve of nutriment. Starch is isomeric with cellulose, which forms the cell walls. It is obtained by macerating the parts which contain it

as a dry white powder, which swells up when boiled with water and gelatinizes on cooling. It gives a characteristic blue colour with a solution of iodine. It exists in the form of granules, which are produced by the **plastids**. These are always stratified in layers, around a hilum, which consist of granulose and cellulose alternately. Their size varies from the merest point seen under the microscope to $\frac{1}{1000}$ inch or larger, and their shape is characteristic of the plant which contains them.

Dextrin occurs as the result of the action of diastase on starch. It is soluble, but not crystallizable.

Inulin is also in solution in the cell sap of many plants, *e.g.*, in Compositæ—in tubers of dahlias and artichokes. It is soluble and crystallizable, as also are the gums and mucilages which belong to the same group.

The saccharoses ($C_{12}H_{22}O_{11}$) are cane-sugar and maltose.

Cane-sugar, as is well known, occurs in the juices of many plants, as sugar-cane, maple, and beet-root. **Maltose** results from the action of diastase on starch.

The glucoses ($C_6H_{12}O_6$) are: **Dextrose**, in grapes and many other fruits and parts of plants; and **lævulose**, an invert sugar, which occurs in many fruits, especially dried ones.

The sugars are derived from the hexatomic alcohol **mannite** ($C_6H_{14}O_6$), which occurs in the cell sap of *Fraxinus excelsior* and other plants.

2. **Glucosides** occur in many plants. They are substances which by association with an enzyme give rise to glucose and another body—*e.g.*, amygdalin, coniferin, salicin, sinalbin.

3. **Hydrocarbons** occur as oily drops throughout vegetable protoplasm. They are especially abundant in seeds, in many of which the oil is a non-nitrogenous reserve material, as in palm, castor-oil plant, rape and flax seeds, and fruits such as olives. As elsewhere, they are combinations of glycerine and fatty acids.

4. There are **essential oils** in various parts of plants which give a characteristic odour, such are camphor, terpene, eugenol, and the volatile oils and flavourings in fruit and flowers.

5. **Organic acids** are common, such as the palmitic and oleic fatty acids, as well as oxalic, salicylic, boric, malic, tartaric, citric,

acetic and tannic acids, which are usually in combination with alkaline or saline bases.

A review of the various divisions of the vegetable kingdom shows that foods are derived mainly from the following Natural Orders:

The **Fungi** are a large class from which very few articles of food are drawn. They are principally:

1. The truffle (*Tuber æstivum et brumale*) and the morel (*Morchella esculenta*), both of which belong to the subclass Ascomycetes.

2. The mushrooms: Several varieties of the subclass Basidiomycetes, N.O., Hymenomycetes. The common mushroom is *Agaricus campestris*, but there are other edible varieties. Poisonous kinds are *Lactuarius torminosus* and *A. muscarius.*

The **Phanerogams** contain very many food-producing Natural Orders, as follows:

1. Palmaceæ contains the date-palm (*Phœnix dactylifera*), a native of Asia and Africa; and the sago-palm (*Metrolyxon rumphii et læve*), grown in the Moluccas, contains starch grains in the tissues of the trunk, which, being extracted and prepared, form sago.

2. Graminaceæ yields some of our most valuable food stuffs—*e.g.*, maize (*Zea maïdis*), cultivated in warm countries and a native of America; sugar-cane (*Saccharum officinarum*), a native of India and cultivated in tropical districts; rice (*Oryza sativa*), cultivated in Asia, America, and Southern Europe; the varieties of oats (*Avena sativa*); barley (*Hordeolum sativum* and varieties); wheat (*Triticum sativum* and varieties); rye (*Secale cereale*); durra (*Sorghum vulgare*).

3. Liliaceæ contains onion (*Allium cepa*), shalot (*A. ascolonicum*), chives (*A. Schœnoprasum*), leek (*A. porrum*), garlic (*A. sativum vel vulgare*), asparagus (*Asparagus officinalis*).

4. Bromeliaceæ contains pineapple (*Ananas sativa*), the fruit of which is a berry; the berries of each flower coalesce and form a spurious fruit. Under cultivation they contain no seeds.

5. Musaceæ: Banana (*Musa sapientum et ensete*), and plantain (*M. paradisaica*).

6. Marantaceæ: The true or West Indian arrowroot is a starchy powder obtained from *Maranta arundinacea.*

7. Zingiberaceæ: The East Indian arrowroot is the starch obtained from the rhizome of *Curcuma angustifolia et leucorrhiza* of this order; ginger is the rhizome of *Zingiber officinale;* cardamoms the seeds of *Eletteria cardamomum.*

8. Orchidiaceæ: Oil of vanilla is a flavouring essence derived from *Vanilla passiflora.*

9. Moraceæ: Fig (*Ficus carica*), mulberry (*Morus alba et nigra*), and bread-fruit (*Artocarpus incisa*).

10. Juglandeaceæ: Walnut is the fruit of *Juglans regia.*

11. Chenopodiaceæ: Spinach (*Spinacia oleracea*), red beet (*Beta rubra*), sugar-beet (*B. altissima*), and mangold (*B. vulgaris*).

12. Magnoliaceæ: Chinese or star anise (*Illicium anisatum*).

13. Myristicaceæ: Nutmeg and its mace (*Myristica moschata*).

14. Polygonaceæ: Garden rhubarb, the leaf-stalks of *Rheum rhaponticum et undulatum.*

15. Cruciferæ: Contains a large number of important green vegetables, as—Watercress (*Nasturtium officinale*), cabbage (*Brassica oleracea*), scotch-kale or cow-cabbage (*B. acephala*), savoy (*B. bullata*), red and white cabbage (*B. capitata*), brussel sprouts (*B. gemmifera*), brocoli (*Botrytis asparagoides*), cauliflower (*B. cauliflora*), turnip (*Rapa depressa*), turnip cabbage (*Napo brassica*), swede turnip (*Rutabaga*), mustard (*Sinapis alba et nigra*), horseradish (*Cochlearia armoracia*), sea-kale (*Cakilina*), pennycress (*Thlaspi*), cresses (*Senebiera et Lepidium*), radishes (*Raphanus sativus*).

16. Capparidaceæ: Capers are the flower-buds of *Capparis spinosa.*

17. Ternstrœmiaceæ: Black and green tea (*Thea chinensis*).

18. Sterculiaceæ: Cocoa and chocolate prepared from *Theobroma cacao*, a tree of tropical America; kola, the seeds of *Cola acuminata*, a tropical African tree.

19. Linaceæ: Linseeds from *Linum usitatissimum.*

20. Erythroxylaceæ: The leaves of coca (*Erythroxylon coca*).

21. Rutaceæ: The suborder Aurantieæ contains the citron (*Citrus medica*), lime (*C. limetta*), lemon (*C. limonum*), bitter orange (*C. vulgaris*), sweet orange (*C. aurantium sinense*), and many varieties).

22. Ampelidaceæ, suborder Vitaceæ, contains grapes (*Vitis vinifera*, and many varieties).

23. Euphorbiaceæ: Tapioca, obtained from cassava, the feculum of *Manihot utilissima*.

24. Umbelliferæ: Many useful plants, as—carrot (*Daucus carota*), parsnip (*Pastinaca oleracea*), celery (*Apium graveolens*), parsley (*Petroselinum sativum*), aniseed (*Pimpinella anisum*) carraway seeds (*Carum carui*), fennel (*Fœniculum*), angelica (*Archangelica*), and samphire (*Crithmum*), which grows on rocks of the seashore.

25. Cucurbitaceæ: Pumpkin (*Cucurbita pepo*), cucumber (*Cucumis sativa*), melon (*C. melo*), water-melon (*Citrullus vulgaris*).

26. Papayaceæ: The papaw (*Carica papaya*), an edible fruit of the tropics containing a rich proteolytic ferment, papain.

27. Myrtaceæ: Cloves (the flower-buds of *Eugenia caryophyllus*), pomegranate (*Punica granatum*), Brazil nuts (the seeds of *Bertholletia exelsa* of tropical countries).

28. Rosaceæ: The genus Pruneæ contains almonds (the seeds of *Amygdalus communis*), peach (*Prunus persica*), sloe (*P. spinosa*), apricot (*P. armeniaca*), plum (*P. domestica* and varieties), cherry (*P. cerasus* and varieties), damson (*P. mahaleb*).

The genus Pomeæ has the quince (*Cydonia*), pear (*Pyrus communis* and varieties), and apple (*P. malus* and varieties).

To the genus Rubus belong the raspberry (*Rubus idæus*), blackberry (*R. fructicosus*), dewberry (*R. cæsius*); and the strawberry (*Fragaria* and varieties, genus Fragaria).

29. Leguminosæ: The legumes include peas (*Pisum sativum et arvense*), beans (*Vicia faba*), lentils (*Lens esculenta*), French bean (*Phasiolus vulgaris*), and scarlet runner (*P. multiflorus*).

30. Saxifragaceæ: To the tribe Ribesieæ belong the red and black currants (*Ribes rubrum et nigrum*), and gooseberries (*R. grossularia*).

31. Labiatæ contains the sweet herbs: Mint (many varieties of mentha), thyme (*Thymus vulgaris*), basil (*Calamintha arvensis*), sweet marjoram (*Origanum marjorana*), sage (*Salvia officinalis*), savory (*Saturia hortensis*).

32. Convolvulaceæ: The sweet potato is the tuberous rhizome of *Batatas edulis* of tropical America.

33. Solanaceæ contains potato (the tuber of *Solanum tuberosum*), tobacco (*Nicotiana tabacum*), Chili peppers (the fruit of *Capsicum longrum*), tomato (the fruit of *Lycopersicum esculentum*).

34. Dioscoreæ: Yams (the tuberous roots of *Dioscorea sativa* and other plants of the tropics), rich in starch.

35. Oleaceæ: Olives (the fruit of *Olea Europæa*), grown in South Europe and Eastern countries.

36. Vacciniaceæ: Cranberry (*Vaccinium oxycoccos*), great bilberry (*V. uliginosum*), bilberry or whortleberry (*V. myrtillus*), red whortleberry (*V. vitis-idæa*).

37. Rubiaceæ: Coffee (the fruit or berries of *Caffea Arabica*).

38. Caprifoliaceæ: Elderberry (*Sambucus nigra*).

39. Compositæ: This large order yields us lettuce (*Lactuca sativa*), dandelion (*Taraxacum officinale*), salsafy (*Tragopogon porrifolius*), endive (*Cichorium endivia*), chicory (*Cichorium intybus*), Jerusalem artichokes (the tubers of *Helianthus tuberosus*).

The above list gives abundant examples of the foods derived from the vegetable kingdom, but completeness is not claimed, nor will the order here given be adhered to in the following pages, as it is believed a better purpose will be served by grouping them together in various sections.

FRUIT.

Fruit contains sugar, salts, organic acids, and a gelatinizing principle called **pectin**. The nutritive value of fruit depends largely upon its proportion of sugar. Fruit-sugar or grape-sugar is glucose or dextrose, $C_6H_{12}O_6$. Many fruits contain a large amount of it; thus, grapes have 10 to 25 per cent.; dried figs, 60 to 70; cherries, 11; mulberries, 9; currants, strawberries, and whortleberries, each 6; and raspberries, 4. Fruit also contains a proportion of **lævulose** ($C_6H_{12}O_6$), or invert sugar, which is uncrystallizable, and when pure is a syrup; it exists in company with dextrose in many fruits and vegetables, especially in grapes, figs, cherries, gooseberries, strawberries, peaches, and plums. In fruits which are dried the lævulose increases at the expense of the dextrose, which is inverted by means of a ferment or enzyme, as in raisins; during the drying some of the remaining dextrose is formed into an amorphous or crystalline mass. Wynter Blyth[1] gives the following composition of fruits as the result of many analyses:

Percentage Composition.	Water.	Nitrogenous Substances.	Free Acids.	Sugar.	Other Non-nitrogenous Substances.	Woody Fibre, etc.	Ash.
Apples	83·58	0·39	0·84	7·73	5·17	1·98	0·31
Pears	83·03	0·36	0·20	8·26	3·54	4·30	0·31
Plums	81·18	0·78	0·85	6·15	4 92	5·41	0·71
Prunes	84·86	0·40	1·50	3·56	4·68	4·34	0·66
Peaches	80·03	0·65	0·92	4·48	7·17	6·06	0·69
Apricots	81·22	0·49	1·16	4·69	6·35	6·27	0·82
Cherries	80·26	0 62	0·91	10·24	1·17	6·07	0·73
Grapes	78·17	0·59	0·79	24·36	1·96	3·69	0·53
Strawberries	87·66	1·07	0·93	6·28	0·48	2·32	0·81
Raspberries	86·21	0·53	1·38	3·95	1·54	5·90	0·49
Bilberries	78·36	0·78	1·66	5·02	0·87	12·29	1·02
Blackberries	86·41	0·51	1·19	4·44	1·76	5·21	0·48
Mulberries	84·71	0·36	1·86	9·19	2·31	0·91	0·66
Gooseberries	85·74	0·07	1·42	7·03	1·40	3·52	0·42
Currants	84·77	0·51	2·15	6·38	0·90	4·57	0·72

The organic acids in fruit are citric, malic, acetic, tartaric, oxalic, salicylic, and boric acids, alone or in combination with bases to form salts of potassium, sodium, calcium, etc., and they are mingled with phosphates, carbonates, sulphates, and chlorides of such bases in smaller proportion. Malic acid is in considerable quantity in apples, pears, red and white currants, blackberries, raspberries, the berries of the mountain ash, quinces, pineapples, and Morella cherries; malates in sweet cherries, rhubarb, etc.; oxalates in tomatoes, plums, gooseberries, strawberries, and raspberries; citric acid and citrates in lemons, oranges, quinces and lime fruits, gooseberries, strawberries, and raspberries; tartaric acid is found chiefly in grapes, though it exists also in other fruit and vegetables; salicylic acid occurs, probably in the form of the methyl ester,[5] in currants, 0·57 milligramme per kilo; cherries, 0·4; plums, 0·28; grapes, 0·32; crab-apples, 0·24; also in strawberries, raspberries, mulberries, blackberries, apricots, peaches, and oranges; and boric acid[6] is found in oranges and lemons, lemon juice containing as much as 0·5 per cent. When fruit[7] is ripening the acids are progressively consumed, with liberation of carbonic acid gas and formation of carbohydrates and ethers.

The flavour and aroma of fruit is due to various ethers, and essences have been prepared in the chemical laboratory by

mixing etherial salts and oils with each other until the odour of every fruit has been imitated. The oil of apples is valerianate of amyl; the flavour of pears is due to acetate of amyl, of pine-apples to butyrate of ethyl, greengage to œnanthylate of ethyl, quince to pelargonate of ethyl, mulberry to suberate of ethyl, and melon to subacetate of ethyl.[8]

The Value of Fruit.—Fruit is eaten fresh or dried, and in the form of marmalade, jam and jelly. Fruit jelly—such as apple or black currant—consists of vegetable gelatine or *pectin* ($C_{38}H_{48}O_{22}$), a carbohydrate chemically combined with acids and related to the gums, together with fruit salts and sugar, a very pleasant and agreeable addition to various culinary preparations.

Jam or marmalade consists of fruit prepared and preserved by boiling in very strong syrup; the chemical composition thereof is that of sugar with fruit and fruit juice, some of the flavour having escaped during cooking owing to its volatility. Home-made jam or marmalade is an excellent article of diet, and for children or others to whom a large proportion of carbohydrate material in the food is essential bread-and-jam forms an excellent meal. Some shop jams are known to have been adulterated by tasteless vegetable tissues—such as marrow or turnip—which is a fraud, although the substituted material may not be injurious to health; and glucose of artificial manufacture has been used to lessen the quantity of sugar required in preserving.

The value and importance of fresh fruit, especially to the dwellers in towns, cannot be too freely written about; they are equal in value to vegetables. The organic acids in fruit arouse the appetite and aid digestion by increasing the flow of saliva and, indirectly, of the gastric juice; they are stimulants and sialogogues. As the fruit reaches the intestines, the acids increase the acidity of the chyme, and stimulate the secretions of the liver and pancreas, the intestinal glands and muscles; their influence upon the blood is marked: they render it less alkaline, *but never acid*, by combining with a portion of the alkaline salts of the serum.[9] The phosphoric acid increases the phosphates in the red blood cells, and the potassium salts promote the formation of white blood cells; hence they are antiscorbutic and of value in anæmia, general debility, and convalescence from acute illness. Fruits containing oxalates—as tomatoes, gooseberries, and strawberries

—are useful in amenorrhœa, and for persons subject to bronchitis and asthma; such as contain salicylic acid—as strawberries, raspberries, currants, blackberries, and oranges—are a valuable addition to the dietary of rheumatic persons. The final stage in the digestion of fruit is the conversion of the fruit acids and salts into alkaline salts, chiefly carbonates; they are therefore useful in scurvy, rheumatism, gout, and other diseases of the uric acid diathesis; they increase the secretion of the urine and its alkalinity—indeed, they are one of the most certain agents to render the urine alkaline, to stimulate the kidneys, and indirectly the skin, and thereby increase the total excretion of salts and other materials. Briefly, fresh fruit is cooling, refreshing, and tends to correct constipation, but in excess may cause diarrhœa.

Apples, the fruit or pome of *Pyrus malus* and many varieties, genus Pomeæ, N.O. Rosaceæ. They are grown universally in the temperate regions of the globe, and form an important article of food, being admirably adapted for cooking, compotes, marmalade, and jelly. The composition of several kinds analyzed by A. H. Allen[10] is as follows:

	Water.	Acid (as Malic).	Glucose.	Sucrose.	Ash.
Blenheim orange ...	81·62	0·88	9·28	6·28	0·44
Derby (cooking) ...	84·74	0·56	8·74	2·29	0·33
Sweet Alfred (cider)	80·29	0 09	9·43	2·95	0·54
Tom Put (cider) ...	84·14	0·36	7·21	2·84	0·44

Browne[11] states that there is 1 to 3 per cent. of starch in some apples, which, together with the acids, is chiefly converted into sugar in the ripe fruit.

Apples for dessert should be characterized by a firm, juicy pulp, piquant flavour, regular form, and beautiful colouring; for cooking, by the property of forming by the aid of heat a pulpy mass of equal consistency. Apples are wholesome food either raw or cooked. They are mildly aperient, and are accorded the property of strengthening a 'weak' stomach. Dyspeptics should not eat too freely of raw apples, but an abundance of cooked ones is not only grateful to them, but curative. They are of singular use for persons of sedentary habits whose livers are sluggish, by assisting to eliminate noxious matters from the body; and as

they contain a larger amount of phosphoric acid in an easily assimilable form than any other fruit, they are also of value as a nervine and a brain food.

Cider is a fermented liquor made from the juice of apples, and is not inferior to some wines when due attention is paid to the selection of the fruit and its manufacture. It contains the acids and salts of the fruit, the acidity being sometimes increased by acetous fermentation. It is drunk largely in some districts. It is considered a valuable remedy for chronic rheumatism and gout, for which **dry cider** is the best kind. Other observers assert that in cider-making counties, where it is much drunk, chronic rheumatism is exceedingly prevalent, and a connection is sought between this frequency and the drinking of cider which would possibly be more readily found in the soil of the district. Cider[12 13] contains, according to various analysts, 2 to 6 per cent. of alcohol by volume, 0·15 to 0·30 acetic acid, 0·08 to 0·2 of malic acid, and 0·25 to 6 of sugar.

Pears, the fruit or pome of *Pyrus communis*, genus Pomeæ, N.O. Rosaceæ; grown wild in many parts of Europe and Asia, from which the numerous cultivated varieties have originated. They are not so commonly used for food as apples, because they are not so well adapted for cooking. Good pears are a delicious dessert fruit. They are characterized by a saccharine aromatic juice, a soft, pearly, liquid pulp, which readily melts in the mouth in some varieties, principally the summer ones, but is firmer in most winter kinds, in some of which the pulp only softens on being stewed or boiled. Pears contain 7 per cent. of sugar, 0·4 of albuminoids, 5·2 of pectose and gum, 3·2 of cellulose, 0·4 of mineral, and only 1·0 of malic acid (Church).[14]

Perry is a fermented liquor similar to cider, made from the juice of pears.

Prickly Pears are the fruit of *Opuntia vulgaris*, N.O. Cactaceæ. A fleshy, succulent fruit, sometimes called the 'Indian fig,' the interior of which is delicious, soft, and comparable to honey.

Quince is the fruit of *Cydonia vulgaris*, genus Pomeæ, N.O. Rosaceæ. It is a handsome yellow fruit, cultivated throughout Asia and in Europe. It is hard and austere when plucked from the tree, but it makes an excellent preserve or marmalade. They give an excellent flavour to any other fruit with which they

are cooked, and make wine with a very fine bouquet by fermentation of the juice.

Plums, the fruit of *Prunus domestica* and varieties, genus Pruneæ, N.O. Rosaceæ. The fruit is a drupe, containing a stone in which is the kernel. There are about a dozen species inhabiting the north temperate zone of the globe. They are much used in cooking for puddings, tarts, jams, and jellies. Analyses show them to contain 6·15 per cent. of sugar, 4·92 of other non-nitrogenous and 0·78 of nitrogenous matters, and 0·85 of free acid. They are an agreeable and refreshing fruit, containing about the same amount of nutriment as apples and pears; but they are apt to cause diarrhœa, therefore weak and delicate persons should avoid them, except when cooked. **Prunes** are a variety of plums (*P. domestica,* var. Juliana), which are largely preserved by drying them. They are of ovoid shape, their exterior black and wrinkled, the pulp brownish. They contain 1·5 per cent. of free acid, but only 3·56 of sugar, 4·68 of other non-nitrogenous matters, and a purgative principle.[15] The latter makes them useful as an aperient, and very suitable for persons subject to constipation. They are grown in France, Spain, California, and other fruit-growing districts. A little art is required in cooking prunes or other dried fruit when it is desired to bring them into the condition of fresh fruit. Let them be first washed in warm water to remove any grit; drain it away; then cover them with cold water, and allow them to stand for twelve hours; put them in a slow oven, and cook gently. They should not be allowed to boil. All kinds of dried fruit should be cooked in the same way.

Damsons are a species of Pruneæ, *Prunus mahaleb.* There are several varieties. The fruit is smaller and finer than plums; they are of similar composition, but have more astringency.

The Sloe is a wild species of plum (*Prunus spinosa*) which grows on a low shrub or tree in hedges and on dry banks. They contain a large amount of tannic and other organic acids, which make the fruit very sour and astringent. These qualities are communicated to a liquor called **sloe wine**, which is very useful for acute or chronic diarrhœa.

Peaches are the drupe of *Prunus Persica*, genus Pruneæ,

N.O. Rosaceæ. Introduced into Europe from Persia, and now grown largely in California, and cultivated in warm or temperate climates in many parts of the globe. The fruit is a large and downy drupe with a kernel, which contains a large proportion of **amygdalin**, and produces prussic acid. There are two sorts—the free-stones and the cling-stones. The fruit, which is delicious, contains about 5 per cent. of sugar, 7·71 of other non-nitrogenous and 0·65 of nitrogenous matters, and 0·92 of free acid. They are mildly laxative, diuretic, and sedative. Poisonous effects have been produced by eating an excessive quantity, owing to the development of prussic acid. **Nectarines** are a variety of the common peach, and sometimes grow on the same tree. Peaches, nectarines, and apricots, containing little sugar, may safely be eaten by the gouty and diabetic.

Apricot is the roundish pubescent fruit of *Prunus Armenica*, genus Pruneæ, N.O. Rosaceæ. This is believed to have been a native of Armenia, hence the name. It was introduced into England about the sixteenth century, but it is grown in many places. It flourishes in abundance in the oases of Africa, where the fruit is dried and carried to Egypt as an article of commerce. Fruit grown in its wild state is more acid than that of the cultivated varieties. Analyses show ripe apricots to contain 4·6 per cent. of sugar, 6·35 of non-nitrogenous, but only 0·49 of nitrogenous matters and 1·16 of free acid; or, according to Desmoulière[16]—saccharose, 3·8 per cent.; invert sugar, 2·25; dextrose, 0·35. When gathered before it is soft and mealy the fruit is of delicious flavour and very agreeable, but may cause diarrhœa if eaten uncooked by delicate persons. **Persimmon** is the fruit of *Diospyros Virginiana* of America, about the size of a small plum, containing a few oval stones. It is astringent when green, but soft, palatable, and very sweet when ripe. Eaten raw, cooked, dried, and made into cakes and wine.

Cherries, the fruit of varieties of *Prunus cerasus*, subgenus Cerasus, N.O. Rosaceæ. The red, red-heart, white-heart, and black cherry are cultivated varieties of *C. avium* and *C. vulgaris*. They contain 1·17 of non-nitrogenous, and 0·62 per cent. of nitrogenous, matters, 10·24 of sugar, and 0·6 of free acid. They are used as a dessert, and for culinary purposes. Cherry brandy or rum and cherry cordial are made by expressing the juice of ripe berries and

mingling it with an equal part of spirit and some spices; when used, they are diluted with hot or cold water.

Grapes, genus Vitis, N.O. Ampelidaceæ. Native of Central Asia, and introduced into Europe by the Phœnicians, but grows in all countries from 55° north to about 40° south latitude. The vine needs a dry climate, because rain spoils the bloom of grapes. The roots are long, and therefore adapted to such a climate. The best known and most important species is the *Vitis vinifera*, of which there are many varieties. They are grown largely in what are known as wine-growing countries—France, Spain, Italy, the Canaries and Azores. The fruit ripens out of doors in England in warm summers. Vineyards were once known in England, and an inferior wine produced from the fruit; but although vineyards are now unknown there, the grapes grown in hothouses are most excellent. As a fruit they are delicious, nourishing and fattening; in large quantities they are diuretic, and will cure constipation and some diseases of the stomach. The 'grape cure' consists in eating several (sometimes many) pounds of the fruit daily, their value being due chiefly to their large proportion of sugar. In phthisis and other wasting diseases care must be taken that they do not cause diarrhœa, as that might aggravate the disease and hasten a fatal termination. On the other hand, sweet grapes, when they do not purge, are exceedingly valuable as a food, and sometimes curative in chronic bronchitis, heart disease, gastric and intestinal atony, and even in Bright's disease they may, when combined with a mild climate, contribute to restoration to health or a prolongation of life. They contain from 12 to 25 per cent. of sugar, about 2 of other non-nitrogenous and 0·6 of nitrogenous matters, besides gum and mucus, with salts, chiefly hydropotassic tartrate or cream of tartar, phosphates, sulphates, and chlorides of lime, magnesia, soda, and potash, and traces of iron, alumina, and silica. The acidity of the unripe grape is due to malic and tartaric acids, and depends upon the period of development and good or bad seasons. As ripening proceeds the malic acid disappears, and free acid then amounts to 0·79 per cent. The sugar of grapes consists of glucose or dextrose, 12 to 25 per cent., besides lævulose or invert-sugar. Grape-sugar, as previously stated, is not peculiar to grapes, but exists in many fruits; it is less sweet than cane-sugar, and can

be artificially produced by the chemical action of a dilute acid on cane-sugar, starch, dextrose, or cellulose. When heated to 400° F. it becomes **caramel**, which is used as a colouring agent for cooking and other purposes.

Raisins (*Uvæ*) are the dried fruit of various species of the vine. There are several good varieties, as Valencias, lexias, and muscatels. Sultanas are a small seedless variety. In the preparation of raisins the fruit is dried by natural or artificial heat. Muscatels are produced by cutting partly through the stalk, and allowing the half-separated fruit to hang on the vine and dry in the sun. Lexias, on the other hand, are pulled from the stalk and dipped in a prepared liquor, and then spread upon baskets to dry in the sun. Raisins contain grape-sugar and lævulose, also tartrate of potassium and other salts. They are refreshing, nutritive, demulcent, balsamic, sweetening and flavouring agents, and are useful to some extent in treating the same diseases as grapes. It is urged by some authorities that raisins, and especially the expressed juice, save the nitrogenous tissues and lead to a formation of fat, increase the flow of urine, but diminish the output of urea and uric acid, are laxative, but check intestinal fermentation, and stimulate the hepatic functions, especially the secretion of bile. They are a ready means of supplying carbohydrate food for people during long walks or climbing, and, being of small compass, can be easily carried. Their demulcent property is also calculated to check the thirst which is so often troublesome to travellers.

Currants.—The dried currants of the shops are a small kind of grape cultivated in the Levant, Morea, and some of the Greek islands, of which they form a staple product. Of various kinds, Vostizzas are excellent and Patras are moderately good. The fruit is plucked from the stalks, dried in the sun, and packed in large wooden receptacles. They are much used in cookery, and have the same chemical composition and properties as raisins.

Strawberries are the fruit of several species of the genus Fragaria, N.O. Rosaceæ. They are cultivated in most cold or temperate climates, in Europe, America, and the mountains of Asia. They are much used for dessert and for cookery, being especially grateful to invalids, and are cooling, diuretic, and laxative. They contain 1·07 per cent. of nitrogenous matter, 6·28 of sugar, 1

of free acids, besides other fruit salts. Salicylates, chiefly as **methyl salicylate,**[17] are a normal constituent of this fruit, for which reason they are especially good for rheumatic and gouty persons.

Raspberries.—The fruit of *Rubus idæus*, red and white, genus Rubus, N.O. Rosaceæ. Native of Great Britain and parts of Europe. They contain 0·53 per cent. of nitrogenous matter, 3·95 of sugar, 1·54 of other nitrogenous substances, 1·38 of free acid, and other organic salts. They are not so nutritious as strawberries, but are used in cooking, confectionery, various liquors and cordials, and to make raspberry vinegar. They are said to be valuable for nervous and bilious people, and are useful in relaxed conditions of the bowels. Raspberry vinegar is pleasant and acidulous, and, being diluted, is suitable as a drink in feverish conditions. The **yellow raspberry**, or cloudberry, is essentially diuretic. The **dewberry** (*R. cæsius*) is a pleasant fruit having tonic and astringent properties. **Blackberry** (*R. fructicosus*), the fruit of the common bramble, contains 4·5 per cent. of sugar, 1·75 of other non-nitrogenous and 0·5 of nitrogenous material, and 1·19 of free acid. Owing to the large proportion of seeds, they are not very nutritive, but they are used in culinary art along with apples and other fruit to make tarts and jam, to which they give a delicious flavour, and they make an agreeable jelly. They are astringent and tonic, and useful in relaxed conditions of the bowels.

Bilberries.—The fruit of *Vaccinium uliginosum*, N.O. Vacciniaceæ, a shrub growing in Scotland and elsewhere. They contain 5 per cent. of sugar, 0·87 of other non-nitrogenous matter, 0·78 of nitrogenous matter, 1·02 salts, besides 1·66 free malic and citric acids, but no tartaric or oxalic acids. The carbohydrates are glucoses, pentoses, and inosital.[18]

Whortleberry, or lesser bilberry (*V. myrtillus*), and red whortleberry (*V. vitis-idæus*), belong to the same order. Their juices are reputed useful for chronic diarrhœa and rheumatism.

Cranberries. — The fruit of *V. oxycoccos*, N.O. Vacciniaceæ. They grow on peat bogs and other swampy areas. They contain a very large amount of free acid, which renders them a very austere fruit when used alone; nevertheless, they are used in tarts and jam, and make a well-flavoured jelly and sauce. Like the previous berries, they are reputed beneficial for chronic

rheumatism, presumably from the excess of acids, which, by their combination with alkaline bases, stimulate the kidneys and render the urine more alkaline.

Mulberries are the fruit of *Morus alba et nigra*, N.O. Moraceæ. They contain 9·25 per cent. of sugar, 2·31 of other non-nitrogenous and 0·36 of nitrogenous matters, 1·86 of free organic acids, and some salts; as a fruit they are about as rich in nutriment as cherries; the black variety are most esteemed. They are a cooling, laxative fruit, used as dessert and for making syrup. Mulberry and apple juice combined make a cider of port wine colour.

Gooseberries.—The fruit of *Ribes grossularia*, N.O. Saxifragaceæ, a spinous shrub. The fruit of different species varies in size, colour, and hairiness; a wholesome fruit, useful for plethoric and bilious persons, and to make a jelly suitable for invalids. Average analysis: 7 per cent. of sugar, 1·42 of free acid, and 1·5 of non-nitrogenous principles.

Currants.—Fruit of varieties of Ribes, tribe Ribesieæ, N.O. Saxifragaceæ. There are the red currant, *R. rubrum;* white, *R. album;* and black, *R. nigrum;* used for dessert, jam, jelly, wine. They have a slightly diaphoretic action, soothe an irritable throat, quench the thirst, and cool the system. Analysis: 6·4 per cent. of sugar, 0·9 other non-nitrogenous and 0·5 nitrogenous substances, 2·15 of free acid, and 0·7 of other salts. The berries of *R. sanguineum* are darker than *R. rubrum;* they are insipid, and incorrectly ascribed with poisonous properties.

Elderberries. — Fruit of *Sambucis nigra*, N.O. Caprifoliaceæ. The juice is a gentle laxative and alterative, useful for rheumatism and other chronic ailments; occasionally used for adulterating port wine; an agreeable wine and spiced cordial is made from it.

Barberries, *Berberis vulgaris*, N.O. Berberidaceæ. The fruit is extremely acid, but makes an agreeable jelly, which allays thirst and feverishness, and is reputed good for atony of the stomach and torpid liver. Analysis: 15·58 per cent. of stones and skin, 5·92 malic acid, 4·67 glucose, 6·61 gum, 0·06 ashes, 67·16 water.[19]

Rhubarb is not a fruit, but its use as such credits it with a place along with them. It is the leaf-stalk of *Rheum rhaponticum et undulatum*, N.O. Polygonaceæ. It is a valuable article of diet,

rich in vegetable salts, and is in season when fruit is scarce. Its acidity is largely due to oxalates and malates of potash and other alkaline bases, which render it stomachic, tonic, and aperient, useful to persons with amenorrhœa, or with asthmatic or bronchitic tendency; but it is contraindicated in gravel, calculus, gout, and some cases of rheumatism. The juice of rhubarb and lemons mixed, and sweetened with sugar, becomes charged with carbonic gas after being bottled for a few days, and is a refreshing beverage.

Oranges.—Sweet oranges are varieties of *Citrus aurantium sinense;* bitter oranges, *C. vulgaris;* suborder Aurantieæ, N.O. Rutaceæ. The orange-tree is a native of India and China, but is grown in Italy, Spain, Portugal, and other parts of South Europe, and in many warm and sunny districts and islands of Asia, Africa, and America. The fruit is globular, bright yellow, divided into eight or ten segments, each of which is filled with a mass of oblong vesicles containing a juicy pulp; the rind contains an essential oil of aromatic and characteristic odour. It is one of the most fragrant and delicious fruits provided by Nature; it is not largely nutritious, but has antiscorbutic and other valuable salutary properties. They are as useful in illness or convalescence as they are acceptable in health, and in feverish conditions, when fruit is not entirely contraindicated, their juicy pulp is antifebrile, and has been credited with specific curative properties in influenza. **Orangeade** is a drink made by adding the juice of oranges to an infusion of fresh orange-peel in boiling water; agreeable in feverish conditions.

Bitter or Seville oranges (*C. vulgaris*) are used along with sweet oranges to make marmalade, the fruit being sliced and preserved in strong syrup. Marmalade is nutritious to the extent of the sugar contained in it, and antiscorbutic by its salts; it is appetizing, and forms an unstimulating addition to our food. It should consist wholly of fine selections of fruit, but adulteration is not uncommon.

The peel is stomachic and aromatic; that of both bitter and sweet oranges is dried and candied, and used for flavouring puddings, cakes, and confectionery. The juice of Valentia oranges[20] contains 10·9 per cent. total solids, 1·7 citric acid, 7·6 sugar, 0·52 ash, 0·027 phosphoric acid, and the juice of others

is of similar composition. The oil of sweet oranges contains terpenes, decylic aldehyde, dextra-linalool, nonyl-aldehyde, and caprylic acid.

Lemons, the fruit of *C. limonum*, suborder Aurantieæ, N.O. Rutaceæ. The lemon, though a native of India, grows freely in South Europe and warm countries generally. Its constitution resembles that of an orange, but the pulp is much more acid, and yields a fragrance and a juice which is used as an ingredient of many delicious liquors. The peel or rind yields an aromatic oil (**essence of lemon**), which is used as a flavouring agent; and the peel, dried and preserved or candied, is used as a dessert and in cookery, and is an aromatic stomachic. The juice contains citric, malic, and phosphoric acid, both free and combined with potassium and other bases; it is cooling, stimulating, and soon quenches thirst. It is particularly suited to people of bilious or sanguine temperament, but those with an irritable stomach should avoid it. Lemon-juice enters the blood in the form of alkaline citrates, which are in part oxidized in the system into carbonic acid and water, and render the urine alkaline; while the salts of potassium and phosphoric acid act upon the red corpuscles of the blood, of which they are both important elements. It is used with great success in the treatment or prevention of scurvy, the cause of which is obscure, but is undoubtedly connected with the absence of *fresh* vegetables and *fresh* animal food from the diet; it is, therefore, an important item of a ship's stores for long voyages. Lemon juice is also of some value in the treatment of menorrhagia, as a spray to the nostrils in nasal catarrh, and as a local application to the throat in diphtheria and other septic forms of tonsillitis or pharyngitis, and for diphtheritic conjunctivitis. In acute illness it is chiefly used for making cooling drinks, such as lemon water or effervescing draughts.

The oil of lemon[21] contains citral, nonyl-aldehyde, octyl-aldehyde, citronellal, dextro-limonene, cymene, phellandrene, and pinene.

Citron, or *C. medica*, and **Lime**, the fruit of *C. limetta et acida*, belong to the same order; they are acidulous, antiscorbutic, and antiseptic; they increase appetite, check nausea and vomiting, stimulate the liver, and are of undoubted value for scurvy and rheumatism. The juice is the part used; as much as ½ pint a

day has been given in acute rheumatism, in which it acts as a refrigerant and neutralizes the poisons of the disease. It is a convenient medium for the administration of pepsin, 5 grains of which is mixed with a tablespoonful or two of the juice, and diluted with a little effervescing potash or soda water. It is also used for flavouring punch, sherbet, and other drinks.

Lemon juice contains 5·5 per cent., and **lime juice** about 7, of free citric acid; they contain likewise small quantities of acetic, formic, and other organic acids, together with sugar and mucilage. The British Board of Trade has established a standard of strength for these juices: they should have a density of 1·03, and an acidity equivalent to 30 grains of citric acid in each ounce.[22] Lime juice is colourless, somewhat opaque, and extremely sour; it is expressed in bulk in Sicily and England, and preserved by the addition of 2 ounces of brandy to each pint, or some boric or salicylic acid, and is occasionally adulterated by the addition of mineral acids.

Lemon water.—Squeeze the juice from two big lemons, and put it aside; cut the lemons into very thin slices or scrape them to pieces; put them into a saucepan with 2 pints of water and 2 ounces of sugar; boil them for five minutes, and pour the liquor upon the lemon juice; strain; when cold it is ready for use. It may be made of greater strength, and diluted when drunk with Apollinaris, Salutaris, or other effervescing water. It is very useful in all febrile conditions, and in nausea and vomiting. In some cases of vomiting and diarrhœa, when all else is rejected, the white of an egg whipped up and mixed with $\frac{1}{4}$ pint of lemon water will often remain in the stomach, thereby providing nutriment and assisting to check the disease. Meat essences may also be given in it.

Lemon kali is the name given to (*a*) a pleasant effervescing drink made by mixing lemon juice or citric acid in a solution of bicarbonate of potash and sweetened water; (*b*) a powder composed of tartaric acid, citric acid, sugar, and carbonate of soda, which will effervesce when mixed with water, and make a pleasant drink.

Lemonade.—Take 1 lemon, 1 ounce of citric and tartaric acid, the white of 3 eggs, $1\frac{1}{2}$ ounces of sugar, 3 pints of boiling water. Squeeze the juice from the lemon, slice the lemon and put it

with the tartaric and citric acids and sugar, and pour on it the boiling water; strain it when cold; beat up the egg-whites to a froth and mix them in the cold liquid; bottle it, and it is ready for use. Dilute it with three or four times its volume of water when it is drunk; the addition of half a teaspoonful of bicarbonate of soda to each tumblerful will convert it into an effervescing beverage.

Acid Drinks.—There is a current opinion that lemon juice, lime juice, and other acid drinks, will cure or prevent obesity. There is little doubt that they will do this, and lime juice is the least injurious of the acids used as an anti-fat. But the consumer should be warned that they may do more; very few stomachs can stand an excess of acids for very long, and they cause not only loss of flesh, but of colour and freshness, and health and vivacity may be destroyed.

Tamarind, the fruit of *Tamar Indica*, N.O. Leguminosæ. A cooling acid fruit, containing sugar, cream of tartar, acetic and citric acids, as well as various aromatic acids; it is refrigerant and gently laxative. **Tamarind whey** is an agreeable cooling drink, made by mixing 1 ounce of tamarind pulp in $1\frac{1}{2}$ pints of milk. Infusion of tamarind is made with the same proportion of hot water; these drinks are particularly grateful to persons suffering from feverish and inflammatory diseases. The fruit is imported from the East and West Indies. The latter are prepared by putting them into jars with layers of sugar between them, or by pouring boiling syrup on them; the pulp of the former is most esteemed, and is preserved by the addition of salt and dried in the sun.

Pomegranate, the fruit of *Punica granatum*, N.O. Myrtaceæ, is a fruit as large and round as an orange, with a hard rind, and interior divided into compartments containing pulp and seeds; the pulp is subacid, but of pleasant taste; the rind is highly astringent, and contains **pelletierine**, an alkaloid which is powerfully destructive to tapeworms. The expressed juice of the ripe fruit contains 0·51 per cent. of acids and 10 to 13·6 of sugar.[23]

Tomato, the fruit of *Lycopersicum esculentum*, N.O. Solanaceæ. Grows in all warm and temperate climates; is a most excellent fleshy fruit; eaten raw, roasted, or boiled, in soup, sauce, salad, or ketchup. Composition: Saccharine matter, carrotin, organic

salts, a brown resinous substance, an acrid volatile oil, and an alkaloid. Reported to have a beneficial effect on the secretions of the liver.

Pineapple, *Ananas sativa,* N.O. Bromeliaceæ. The pineapple is a spurious fruit, or, rather, a collection of berries, each corresponding to a flower; under cultivation they are seedless. The whole forms one of the most fragrant and delicious desserts, the juice of which is very grateful. A piece of pineapple taken at the end of a meal materially aids digestion by yielding a proteolytic ferment capable of converting albuminates into peptone; the juice, in doses of a tablespoonful or more, is very beneficial in cases of chronic bronchitis, attended by the secretion of tough and tenacious mucus.

Papaw is the fruit of *Carica Papaya,* N.O. Papayaceæ, grown in the tropics. It contains a milky juice, which when dried constitutes **papayotin**. The active principle is an enzyme or proteolytic ferment called **papain**, which will assist digestion of meat by its action upon the sarcolemma, whereby it exposes the albuminous or sarcous elements to the influence of the pepsin in gastric juice. The fruit, or its active principle, may therefore have a wide sphere of usefulness. The juice can be obtained commercially, and may be taken in doses of 10 drops after meals, and papain is taken in doses of 5 to 10 grains in cachet or dissolved in glycerine; as a sedative to the stomach in gastralgia, vomiting, flatulence, acid eructations, gastric ulcer, atony of the stomach, and other diseases, in which the aid of digestants is deemed desirable. **Papain** is a white, somewhat granular powder, $\frac{1}{2}$ gramme of which will digest 1 pint of milk in thirty minutes. Papaw juice acts as a galactogogue, but neither the fruit nor its preparations can be taken safely by pregnant women.

Papayotin is used industrially in the preparation of meat essences and other foods. Reports of its activity are conflicting. Emmerling[24] has particularly investigated it, and found it to be active in an alkaline medium; its action on meat is slow, fresh additions of papayotin being necessary from time to time, but the resulting mixture contains a large proportion of albumose and peptone, showing that the enzyme has decided proteolytic power.

The **fruit**, when green, is an excellent vegetable, resembling vegetable marrow, and is boiled and eaten with meat. The

papaw of North America is a sweetish, edible fruit belonging to Ananaceæ.

Melon, the fruit of *Cucumis melo*, and **Water-melon**, *Citrullis vulgaris*, N.O. Cucurbitaceæ. In nearly all hot countries the melon is esteemed as a delicious, cool, succulent fruit, rich in juice, which is highly flavoured, but of no very high nutritive value. **Water-melon** (*C. vulgaris*) is diuretic and demulcent, useful in irritation of the kidneys and bladder, and a mild intestinal and hepatic stimulant; it grows in most hot and dry regions, especially on a warm and sandy soil: in Egypt, India, China, Japan, the West Indies, and America. It forms a large portion of the meat and drink for the population of North Africa during some months of the year. The fruit has a rich, delicious flavour, and an abundant watery juice of sweetish taste, for which it is highly prized.

Plantain, the fruit of *Musa paradisaica*, N.O. Musaceæ, has a luscious, nutritive pulp; it is larger than the banana, for which it is sometimes sold, and is eaten raw or fried in slices. An extremely useful food to the natives of tropical countries. They are excellent when roasted in ashes, and when green they may be boiled and eaten as a vegetable.

Banana, the fruit of *Musa sapientum* and other varieties, N.O. Musaceæ; cultivated in tropical and subtropical countries, not confined to any region of the torrid zone. Bananas are too well known to need description. The pulp is soft, of delicious and luscious flavour, and contains a good proportion of nitrogenous and carbohydrate material. They are eaten raw or fried in slices, and the green fruit is boiled as a vegetable. The pulp is also dried and ground into flour, which is used in invalid foods, and can be made into cakes and biscuits, and even into bread when mixed with the more glutinous flour of wheat.

Composition.	Water.	Proteid.	Fat.	Carbo-hydrate.	Ash.	Fibre.	Phosphoric Acid.
Ripe fruit, Fiji[25] ...	75·5	1·71	—	20·13	2·45	—	—
Ripe fruit, Jamaica	73·3	1·3	0·6	22·0	0·8	—	—
Banana flour[26] ...	10·62	3·55	1·5	81·6	1·60	1·60	0·26

Banana flour is prepared from the unripe fruit of *M. sapientum*, which is gathered green, before the starch is converted

to sugar, sliced, dried in the sun or by artificial heat, powdered and sifted. It is used for damper, cake, and porridge. The fruit is fit to eat as soon as it has lost all the green colour, and remains fit, no matter how black it may be, so long as the skin is unbroken, for until the latter occurs there can be no admission of air and no decomposition.

In many countries the banana is a far more important article of food than in Europe, for to an immense portion of the human race it is what wheat, rye, barley, and potatoes are to the inhabitants of temperate zones. It is, perhaps, less nutritive than potato and wheat, but it is more productive than any other plant grown for food, and more people can subsist on a given area planted with banana-trees than on an equal space of ground planted with wheat or potato.

Bread-fruit, *Artocarpus incisa*, N.O. Moraceæ, a large, somewhat round and fleshy mass, 6 inches or more in diameter, which is roasted before being eaten. It is a native of the Canaries, South America, and Pacific Islands, and forms one of the principal foods of South Sea islanders. The bread-fruit of tropical Asia is *Artocarpus integrifolia*, called the Jack-tree; the fruit is oblong, and contains seeds like chestnuts, which are roasted and eaten. The bread-nut of the West Indies is *Brosimum alicastrum*. The nuts, when roasted, taste like hazelnuts, and are eaten as bread.

Fig, the fruit of *Ficus carica*, N.O. Moraceæ; has not the same nature as an apple, orange, or other seed-bearing fruit, but is a large receptacle containing an enormous quantity of very small flowers, the ripe carpels of which are called seeds, and are embedded in a pulp. They are eaten fresh or dried, and, containing 60 to 70 per cent. of sugar, are very nutritive. They are natives of the Mediterranean regions. The best come from Turkey, but they are grown in Greece, Syria, Arabia, Spain, South France, and North Africa.

Dates, the fruit of the date-palm, *Phœnix dactylifera*, N.O. Palmaceæ. The best are imported from North Africa, Tunis, Egypt, Palestine, and Persia. **Tafilat** dates are very fine. The fruit is the produce of the female tree, and the bunches are composed of 150 to 200 dates, which weigh 20 to 25 pounds. Very nutritious, eaten fresh or dried; one of the principal foods

of Arabs in the deserts, the fruit being pounded or kneaded into the form of cakes.

Olives, the fruit of the olive-tree, *Olea Europœa*, N.O. Oleaceæ. Grown in Southern Europe and Eastern countries; imported from the South of France, Portugal, Spain, and Italy. Eaten fresh or preserved, they are nutritive and laxative; used as a dessert, and consumed largely by the inhabitants of districts in which they grow as an article of diet. The nutriment consists chiefly of the oil which they contain. **Olive oil**, the finest of which is salad oil—Huile de Provence, Lucca oil—is of a pale greenish colour, mild taste, and very little odour; it consists of 72 per cent. of **olein**, a fluid organic oil or olæoptene, and 28 per cent. of **palmitin**, a solid oil or stearoptene, both being compounds of the corresponding fatty acid and glycerine. An ounce of olive oil a day encourages the action of the bowels and aids digestion in a remarkable way. In larger quantities it has been prescribed as a cure for gall-stones, the oleic acid being supposed to have a solvent power over the gall-stones; but the treatment has met with little success in the writer's hands. As a food olives are wholesome, and are digested in the same way as other fats and oils. The ripe olive contains just what an ordinary vegetarian diet lacks, especially fruit; by being a wholesome source of fat they materially add to the value of other vegetarian dishes. They are of value to sufferers from nervous diseases, rheumatism, liver complaint, Bright's disease, diabetes, and all other ailments in which there is a loss of flesh.

Nuts, such as cob-nuts, filberts, chestnuts (*Castanea vesca*, N.O. Corylaceæ), walnuts (*Juglans regia*, N.O. Juglandeaceæ), Brazil-nuts (*Bertholletia excelsa*, N.O. Myrtaceæ), almonds (*Prunus amygdalus*, N.O. Rosaceæ), contain a large proportion of oil and nitrogenous material, which renders them very nutritious, but many of them are indigestible and somewhat astringent. They should not be eaten by persons of feeble digestive power or subject to constipation; but they are, when well masticated, suitable food for the obese and corpulent, or for those suffering from Bright's disease and diabetes; they may be eaten freely by the latter, a meal being occasionally made of them—indeed, they are less likely to cause indigestion when they form the sole element of a meal than when they are eaten for dessert at the end of an

ordinary full meal. They are sometimes ground into meal or cooked. The French *Galette* is made from chestnut meal with salt, butter, and eggs, and is said to form a more satisfactory food than white bread, and contains the elements of a perfect food in due proportion ; also in France *polenta* is porridge made of chestnut meal and milk.

Brazil-nuts grow on a gigantic tree, *Bertholletia excelsa*, N.O. Myrtaceæ. The fruit is a large, round pericarp of thick wood about the size of a child's head, and divided into four compartments, each of which contains six or eight nuts. Like other nuts, they contain a kind of vegetable milk, also oil, sugar, phosphorus, and the nitrogenous materials necessary to stimulate the growth and maintain the life of the young plant which grows from the kernel. Corenwinder found that fresh kernels have the following composition, which shows them to be a highly nutritious food : Water 8 per cent., oil 65, nitrogenous matter 15·3, carbohydrate 7·39, salts (including 1·35 of phosphoric acid and 2·35 of silica, lime, and potash) 3·70.[27]

Almonds, the seeds of *Prunus Amygdalus communis et nana*, N.O. Rosaceæ. Imported from Spain, Portugal, Turkey, Morocco, Palestine.

Sweet Almonds, *A. communis dulcis*, known as Jordan almonds, are mostly from Valencia, Malaga, and Palestine about the Jordan. They are eaten as nuts, and used for culinary purposes. Ground into flour, almond paste, cakes, biscuits, and bread for persons suffering from diabetes, are made of them. They contain 50 per cent. of the bland fixed oil of sweet almonds, which consists chiefly of olein with some palmitin and stearin, and is of the same value and action as olive oil, but more agreeable. The rest consists of albumin, sugar, gum, fibre, and amygdalin. Being practically devoid of starch, and containing much albumin, they are very proper food for diabetic persons.

Bitter Almonds, *A. communis amara*, mostly from Morocco. They are not used for food, and very little as flavouring agents in cookery. **Essence of almonds** is a preparation made from them or their essential oil. The ripe seed is short and broad, and has a bitter taste. It resembles the sweet almond, which, however, is long and narrow. Their composition is similar to that of the sweet variety. They contain 2 or 3 per cent. of amygdalin, a

glucoside which, in the presence of water, and under the influence of emulsin—an enzyme—breaks up into the volatile or essential oil of almonds, free prussic acid, formic acid, and glucose. The essential oil is highly volatile and poisonous, containing 4 to 8 per cent. of prussic acid. It does not exist in almonds ready made, but is the result of decomposition. Its development can be observed by bruising bitter almonds and triturating them with water, when the odour of prussic acid is emitted. Amygdalin also occurs in sweet[28] almonds, but the emulsin does not, whence prussic acid is not developed. It also occurs in other substances. Thus Lehmann obtained from bitter almonds 2·5 per cent., peach kernels 2·35, plum kernels 0·96, apple seeds 0·60, cherry kernels 0·82, cherry laurel *leaves* 1·38.[29] It likewise exists in the bark of buckthorn, may-blossom, and in small quantities in many other vegetable substances.

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CHAPTER XIV

VEGETABLES

FRESH green vegetables are absolutely necessary for our well-being. Freshness is as necessary as the vegetable itself. Tinned vegetables and fruit have not the same effect. The experience of travellers who go beyond the bounds of civilization, and of sailors who go beyond the reach of fresh green vegetables, is that scurvy and other signs of ill-health arise after being deprived of them for a season, the ill-effects only being prevented by the free use of lime juice. All vegetables contain important salts, malates, oxalates, citrates, tartrates, besides free organic acids, in their juices, which play an important rôle in our physiological economy. Such salts are quite as necessary for our blood and

secretions as proteid material for renewing our tissues and carbohydrate for supplying energy. That scurvy is not merely the effect of change of climate is proved by the fact that it was once a very common disease in England and other countries, when the cultivation of vegetables for food was less common than at the present day; and even now instances occur when persons are deprived of them for a length of time. A vegetable, as cabbage, cauliflower, potato, lettuce, or other salad, should therefore constitute a portion of at least one meal a day.

Vegetables are cooked by boiling, roasting, or baking, and some are equally good food cooked either way. It is better to boil vegetables in soft water, because hard water deposits a layer of lime and other salts upon them which prevents the penetration of heat into their interior, thereby delaying the cooking and sometimes spoiling their appearance.

Persons in robust health, with healthy stomachs, and leading active lives, may eat all sorts of vegetables, however cooked, without injury, except when they are taken in excess. In robust health 'appetite waits on good digestion.' In youth and early manhood the digestive functions are very energetic, much nourishment is needed for the development of the body, and vigorous physical exercise gives an appetite and digestive power which vegetables cannot resist. But in aged persons, in those of sedentary occupation, and invalids, the functions of digestion are neither so powerful nor energetic. The digestion of all things is slower and feebler, and any extra tax upon the stomach, the least excess at table, mental disturbance, or additional physical strain, means discomfort and dyspepsia for days; indeed, there are some vegetables which cannot be digested by these persons under any circumstances. Experience as well as science has established the fact that a dinner is not complete without the conjunction of animal and vegetable food. Therefore, those who are only able to digest vegetables, especially green vegetables, with difficulty should have them in the form of consommé or purée. Both are similar preparations, only a purée, of which mashed potato carefully prepared may be taken as an example, is somewhat thicker than consommé. In their preparation the cooked vegetable is minced and pounded in a mortar until it is reduced to a pulp, and then rubbed through a hair sieve to remove skin

and rough fibres. It is afterwards warmed up in a stewpan or saucepan with a little white *stock* and some cream, and flavoured with pepper and salt. If but little stock and cream be added, it remains thick enough to eat with a fork, and is called a purée. When, however, the sieved vegetable is added to a soup made of white stock and cream or milk, it is called a consommé.* Such also is the soup which is thickened with mashed potato, flour, pea flour, revalenta, and it should have no more consistence while hot than will enable it to adhere slightly to the spoon. Vegetables which, in their ordinary state, create flatulence, dyspepsia, and other distressing symptoms, are when thus treated comparatively free from such deleterious effects.

COMPOSITION OF VEGETABLES : VARIOUS ANALYSES.

	Nitrogenous.	Fat.	Sugar.	Non-nitrogenous Extractives.	Cellulose.	Water.	Salts.
Cabbage ...	1·89	0·2	2·29	2·58	1·84	90·0	1·2
Cauliflower ...	2·53	0·38	1·27	3·7	0·87	90·3	0·8
Brussels-sprouts	4·83	0·46	—	6·22	1·57	86·0	1·2
Spinach ...	3·15	0·54	0·08	3·26	0·77	91·0	1·9
French beans...	2·77	0·14	1·20	6·80	1·14	88·6	0·5
Asparagus ...	1·97	0·29	0·41	2·35	1·15	94·0	0·5
Beet-root ...	1·36	0·04	9·54	9·10	1·07	87·3	0·9
Onions ...	1·59	0·11	2·87	8·06	0·72	86·0	0·7
Carrots ...	1·05	0·22	2·01	8·09	0·89	88·2	0·9
Turnips ...	0·97	0·18	4·10	2·00	0·99	90·2	0·8
Lettuce ...	1·41	0·31	—	2·20	0·72	94·2	1·0
Celery ...	1·49	0·38	0·78	11·31	1·50	85·1	0·9
Mushroom ...	2·57	0·14	1·06	3·81	0·68	91·1	0·7
Morel	3·49	0·25	0·73	3·59	0·67	90·7	0·9
Truffle ...	8·91	0·64	—	7·52	7·93	72·5	2·2

Cabbage or Greens—the large family of Brassicæ, N.O. Cruciferæ —have arisen by descent and cultivation from the wild plant or colewort, *Brassica oleracea.* It includes cabbage, *B. oleracea;* kale or cow cabbage, *B. acephala;* savoy, *B. bullata;* red and white cabbage, *B. capitata;* brussels-sprouts, *B. gemmifera;* broccoli, *Botrytis asparagoides;* cauliflower, *B. cauliflora.* They

* The French consommé is soup made by boiling meat and vegetables together to a jelly. Pot pourré, or olla podrida of Spain, consists of meat and many kinds of vegetables cut into small pieces and stewed together, and Irish stew is a similar concoction.

may be further classified thus : (*a*) Kale or greens, having active leaves ; (*b*) brussels-sprouts, in which the leaf-buds form small heads ; (*c*) cabbage, whiteheart, savoy, and red cabbage, in which only the terminal leaf-bud forms a head ; (*d*) cauliflower and broccoli, in which the terminal bud is active and forms a flower, the other flowers aborting. Cauliflower is the head of the plant modified to form a compact succulent mass ; broccoli merely differs from it in form, colour, and hardness. (*e*) Broccoli sprouts consist of the active open leaf-buds springing from the axils of the leaves.

Seakale is *Cakilinea*, N.O. Cruciferæ.

Spinach is *Spinacia oleracea*, N.O. Chenopodiaceæ.

These vegetables all have antiscorbutic properties ; therefore, while they are valuable as general articles of food, they have a special value and are medically recommended for all persons suffering from skin diseases, anæmia, chlorosis, scrofula, struma, gout, rheumatism, and many other diseases. The composition of cabbage, which may be taken as representative of them all, is : Water, 90·6 per cent. ; albumin, 1·8 ; fat, 0·5 ; starch and dextrin, 5·8 ; mineral salts, 0·8 ; and woody fibre, 0·5. The percentage of nutriment is large in comparison with other green vegetables. Cabbage contains an acrid oil, which is largely removed by boiling. Only young vegetables should be eaten, and especially such as have grown rapidly, or they will not be tender. If they have stood the summer they should have a touch of frost on them to make them tender. With all greens, no matter what their name, the older they are the less tender they will be, and the more difficult their digestion. Cabbage is heavy, and requires a long time for digestion, from which arose a notion that it is very nutritious ; but we have previously shown that the most nutritious meat is not that which requires the longest time for digestion, and the same remark applies to many vegetables. Cauliflower is more easily digested than cabbage ; it is rather flatulent, but can usually be eaten with impunity by persons of weak stomach. Brussels-sprouts are also tender, and usually easy of digestion. Spinach is a soft and succulent vegetable, more easily digested than any of the Brassicæ. It is light and wholesome, somewhat laxative, and useful for chronic constipation. It does not contain much nutriment, but is very valuable

for its vegetable salts and juice. Seakale is easily digested and nutritious; it stimulates the appetite, and is a most wholesome vegetable.

Considerable care is required in the cooking of vegetables, especially those of the Cabbage family. On this depends the flavour, digestibility, and value as a food. Take a savoy or whiteheart cabbage as an example; let it be dressed by removing all faded leaves and as much stalk as possible; quarter it, wash it in cold water, and drain it; put it into a pan of *fast*-boiling water, to each gallon of which is added two tablespoonfuls of salt and a small piece of soda or a teaspoonful of bicarbonate of soda. Let them boil in this for about ten minutes, stirring them down occasionally. They should then be transferred to a second pan of boiling water similarly prepared, and boiled until they are tender. Some authorities recommend even a third water. The whole process of cooking requires from twenty to thirty minutes, according to the size of the cabbage. It should not be cooked so long as to remove all the vegetable juices and salts. Nevertheless, the cooking must be long enough to make it tender, and remove the acrid oil, which causes flatulence and indigestion, the latter being greatly assisted by the soda. When due care is paid to the cooking, these vegetables become as tender as spinach or asparagus, and rival them in flavour.

Asparagus, sparrow-grass, consists of the young shoots of *Asparagus officinalis*, N.O. Liliaceæ. It is wholesome and nutritious, being one of the greatest delicacies of the garden, and particularly valuable for its early appearance. The French or Prussian asparagus is the fleshy spike of *Ornithogalum pyrenaicum*. Asparagus contains albumin or gluten, mannite, malic acid, carbonates and phosphates of lime potash, besides other salts, and **asparagin**, an active principle. The cellular tissue contains a nutritive substance like sago. Asparagin is a crystalline substance which exists also in lettuce, potato, marsh mallow, chestnuts, and other vegetables, and gives to them aperient, diuretic, and deobstruent properties. It soon passes out of the system, and gives to the urine a characteristic odour. Aparagus is an aphrodisiac, and good for nervous complaints, especially palpitation and nervous disorders of the heart.

Vegetable Marrow, *Cucurbita ovifera*, and **Pumpkin**, *C. pepo*,

are of the N.O. Cucurbitaceæ. They make an agreeable change with other vegetables, are very easily digested, and therefore suitable for all persons; and, though not highly nutritious, they contain valuable juices and salts. **Squash** is the fruit of *Cucurbito melopepo*, a kind of pumpkin cultivated in America as a vegetable. Pumpkins and other gourds are grown in all warm countries. The pumpkin is a large round or oblong fruit, originally from India, grown in all tropical and subtropical regions, which is boiled and eaten with other substances to give it a flavour.

Onions, *Allium cepa;* leek, *A. porrum;* shalot, *A. ascolonicum;* and garlic, *A. vulgare*, belong to N.O. Liliaceæ. Garlic contains albumin, mucilage, an acrid volatile oil, salts of potash, lime, iron, magnesia, and silica. Onions contain albumin, gluten, mucilage, uncrystallizable sugar, phosphates, acetates and citrates of lime, soda, potash, magnesia, iron, and silica, together with free organic acids; and the same acrid volatile oil as garlic—viz., **allyl sulphide**. These vegetables all have similar properties, and are valuable, wholesome vegetables; the bulb is the most active part, although the green portion is also valuable. They are stimulant, diuretic, expectorant, soporific, a good nerve tonic, and laxative. They are therefore useful in scurvy, gravel, kidney, and many other diseases. They are not suited to all stomachs alike. Some persons can eat them raw, others can eat them only when boiled or fried, and others not at all. They are most easily digested when boiled, and this deprives them of much of the volatile oil. Onions hold the first position among them as a boiled vegetable. Spanish onions are very mild and sweet; the natives eat them like an apple. Leeks are chiefly used with other herbs to flavour soup; garlic to give a piquancy and flavour to sauces and relishes; while both onions and shalots are used in salads and pickles.

Salsafy, N.O. Compositæ, is grown mainly for its root, which is scraped, stripped of its outer covering or bark, boiled rapidly in water until it is tender, eaten with white sauce flavoured with salt, butter, and lemon juice; it is considered a delicacy.

Turnip, *Rapa depressa;* and swede turnip, *Ruta baga*, N.O. Cruciferæ. These vegetables contain a sweet, juicy, and mucilaginous

substance, capable of being transformed into alcohol by fermentation; but the actual amount of nutriment is small—about 1 per cent. of proteid and 6 per cent. of carbohydrate (starch and sugar). They are used as a vegetable, and also in soup and stews, when firm and of delicate texture, but should be rejected if they are soft, spongy, or fibrous. When eaten they ought to be thoroughly mashed or made into purée, for they are indigestible and create flatulence.

Parsnips, *Pastinaca oleracea*, N.O. Umbelliferæ, are a far more valuable food than turnips; indeed, they are highly nutritious. They contain about 20 per cent. of nutriment, including 2·1 of albumin, 6·9 of starch, 5·5 of sugar, and 6·1 of gum. They are easily digested, and are free from any substance which can create much flatus. Their richness in nutriment has induced various attempts to make bread of them in periods when wheat is scarce, for which purpose the cooked root has been mixed with wheat flour.

Carrots, *Daucus carota*, N.O. Umbelliferæ, a highly nutritive root, containing — water 85 per cent., albumin 1·5, fat 0·2, carbohydrate 10·6, salts 1·0, fibre 1·7, besides a little gluten, pectin, and oil. The salts are malates and earthy phosphates; the sugars are dextrose, lævulose, and mannite. **Carrotin** ($C_{18}H_{24}O$) has a percentage composition of carbon 84·37, hydrogen 9·39, oxygen 6·26. Pectin is the vegetable gelatinizing principle. Carrot juice coagulates when heated, and yields 629 parts of solid matter per 1,000, including albumin 429, carrotin 34, fat 10, salts 6. An infusion or decoction of carrots readily undergoes alcoholic fermentation by reason of the amount of sugar. One ton of carrots yields 12 gallons of alcohol by distillation. Red, yellow, and white carrots are all useful foods. The young root, not fully grown, is tender, nutritious, of pleasant flavour, and easily digested. Fully-grown roots are not so easily digested, and old roots may become very fibrous and as hard as wood, and are unfit for food.

Beet-root, *Beta vulgaris*, N.O. Chenopodiaceæ. There are two varieties of common beet—red beet, or *B. Romana*, and white, or *B. alba*—both of which form an appropriate variation from greens as a vegetable to be eaten with roast meat. They contain 2 per cent. of nitrogenous material and 14 to 20 per cent. of sugar,

and are therefore among the most nutritious vegetables we possess. They are not sufficiently esteemed by the majority. They are also used as a pickle and in salads. In either way they are equally nutritive, refreshing, and quickly digested, and are said to be of especial value for female invalids who suffer from uterine disorders. *Beta altissima* is largely cultivated in France and other European countries for the manufacture of sugar.

Jerusalem Artichoke is the potato-like tuber of *Helianthus tuberosus*, N.O. Compositæ, a species of sunflower. The tubers contain 3 per cent. of nitrogenous material, 14 of sugar, and 2 of inulin, a substance isomeric with starch. Tanret[1] says they contain two carbohydrates—helianthin and synanthrin—which are more soluble than inulin. They are boiled in plain water or milk, and eaten with white sauce, seasoned with pepper and salt. They are also cooked in pies and stews and in various highly-seasoned dishes, the spices of which tend to counteract the griping tendency of the tuber. They are wholesome, refreshing, nourishing, and fattening, but apt to produce flatulence and griping.

Green Artichoke is the flower-bud of *Cynara scolymus*, N.O. Compositæ, a kind of cultivated thistle. Like the former, they are boiled in plain water or milk, and eaten with white sauce, salt, and pepper, but are sometimes eaten raw, with salt and pepper. They are an agreeable delicacy, and easy to digest. They contain inulin and the ordinary constituents of vegetables, but are not of a high nutritive value. The entire plant, as well as the edible portion, contains a bitter juice, which, being mixed with an equal quantity of white wine, is reputed of great service in the removal of dropsy.

Skirret is *Sium Sisarum*, N.O. Umbelliferæ; and *Scorzonera hispanica*, N.O. Compositæ. Each kind is grown for its edible root or tuber. It resembles parsnip in flavour and properties; is cooked by boiling, or half-boiling and frying it, and eaten with white sauce and pepper or other condiments. They are commonly eaten in South Europe and many Eastern countries, as Japan, China, Korea, Siam, Burmah, Cochin China.

Potato, the tuber of *Solanum tuberosum*, N.O. Solanaceæ. The whole family of Solanaceæ are suspected, a great number of its members being narcotic and deleterious. The berry of the potato, called the 'potato-bell,' is poisonous, and many children,

attracted by the beautiful flowers, have eaten and been made seriously ill by them, the symptoms being nausea, vomiting and diarrhœa, followed by giddiness, dimness of sight, dilatation of the pupil, and delirium. The **tuber** of potatoes, however, has no deleterious properties, which is fortunate, seeing that it is a principal food of millions of people, and, next to the cereals, is perhaps the most valuable plant for the production of human food. An acre of potatoes will feed double as many people as an acre of wheat; indeed, there is scarcely any other vegetable product, unless it is the banana, which is capable of feeding so many people from a given area of land.

The nutritive value of the tubers depends upon the amount of starch they contain, which varies from 16 to 23 per cent. They are deficient in proteids, which never exceed 2·5 per cent., and in fat, which is less than 1 per cent.; but they contain a large quantity of vegetable salts, consisting mainly of chloride of potassium, phosphate of potash, iron, magnesia, and lime, besides citric, succinic, oxalic, and malic acids, alone and in combination with bases, which give great antiscorbutic properties to the potato. Balland[2] gives the following result of many analyses of the tuber: Water, 66 to 80 per cent.; nitrogenous matter, 1·4 to 2·8; fat, 0·4 to 0·16; starch, 15 to 29; fibre, 0·75; ash, 0·97 to 1·60; phosphoric acid, 0·26. The salts are 1·79 per cent., and the organic acids give the juice an acid reaction. The nitrogenous matters are albumin, solanin, asparagin, leucin, tyrosin, and xanthin. The **starch**—potato starch—consists of characteristic grains, many of which are large and pyriform, having well-marked concentric lines and a hilum at the smaller end. In bulk, potato starch is a powder of fine, white, granular appearance, inodorous, soft or smooth to the touch, insoluble in cold, but soluble in boiling water. It is extracted from the tuber by due preparation, and is largely manufactured. It is sometimes used to adulterate genuine arrowroot, which it resembles. Mixed with milk and sugar, it forms a food which is easily digested in the stomach and intestines, and is particularly adapted as a substitute for arrowroot for invalids, or, under certain circumstances, for infants. It can also be made into pastry, blanc-mange, cream, or used to thicken soup and gravy; also used to mingle with cocoa or chocolate. It is, indeed,

perfectly wholesome, and equal in nutriment to East or West Indian arrowroot.

By the use of dilute mineral acids and certain ferments as yeast, the starch of potatoes, like other starches, can be transformed into sugar of an uncrystallizable kind, which is used to a great extent in Russia. Sixty pounds of potatoes yield 7·5 pounds of a syrup thinner than treacle, which consists chiefly of glucose and lævulose. This is used for confectionery, sweetmeats, as a substitute for honey, and to adulterate treacle or golden syrup. A spirit which resembles brandy, but has an odour of violets or raspberries, is likewise distilled from the tubers in France and other places, and has been used to adulterate, or as a substitute for, the genuine article.

Potatoes can be cooked in any way—baked, boiled, roasted, fried, steamed, in their skin and without it—or even made into bread. They are certainly best cooked in their skin, as by this method they lose none of their valuable salts. Mashed potatoes are lighter when they have been cooked in their skin. They should be beaten to a paste with a fork, butter or cream and salt being added. Boiled or steamed potatoes should be removed from the fire and the water drained from them immediately they are cooked, otherwise they become waxy or watery and indigestible; but draining and leaving them uncovered near the fire for a short time causes an evaporation of moisture from them, and they become dry and mealy.

The following methods of preparation are specially suited for invalids: (*a*) Boil the potatoes in the skins with salt and water. As soon as they are cooked drain away the water, and dry them thoroughly over a fire. Peel them, and rub the interior through a coarse sieve on to a dish. Avoid touching the sieved potato, and it will remain very light. (*b*) Purée of potato: Beat up a pound of cooked potato with 2 ounces of butter; stir in a teacupful of stock broth, and rub all through a sieve; put it into a saucepan to warm, and serve hot. It will be a little thinner than mashed potato.

Green Peas, varieties of *Pisum sativum vel arvense*, N.O. Leguminosæ; **French or Kidney Beans**, *Phaseolus multiflora et vulgaris*, N.O. Leguminosæ; and **Broad Beans**, *Vicia faba*, N.O. Leguminosæ.

Peas and beans are excellent dietetic vegetables, containing a considerable amount of nutriment, which is a forecast of their value in the ripe and dry condition, when they rival meat. **Green peas and beans** do not rank so high as the ripe and dry ones, but their deliciousness and wholesomeness rivals that of any vegetable grown. Blyth gives the following analysis: **Green peas**—Water, 79·74 per cent.; carbohydrate, 13·03; albumin, 6·06; salts, 1·12. **Green beans**—Water, 91·34 per cent.; carbohydrate, 5·99; albumin, 2·04; and salts, 0·63.

Dried peas, beans, and lentils, contain much nutriment, are exceedingly useful as a diet, sparing the meat required to supply the necessary nitrogen for the tissues, and are quite capable of replacing meat or other animal food. They are not so easily digested as meat, and are apt to give rise to flatus from the development of sulphuretted hydrogen; but they are highly prized by vegetarians for their economic value, and are strongly recommended whenever the cost of meat requires careful consideration. They are also of value in certain conditions of ill-health; for instance, when it is desirable to reduce or entirely refrain from meat, as in gouty conditions, torpidity of the liver, and diseases of the uric acid diathesis. Certain authors claim that, whereas animal food increases the trouble due to gout, rheumatism, and defective metabolism, *leguminous food*, on the other hand, is speedily removed from the system, and does not increase the amount of urea or uric acid produced in the system. They are cooked whole, and the flour is used to thicken soup.

The following is the composition of *dried* peas, lentils, and beans, according to Balland[3 4]:

	Water.	Proteid.	Fat.	Carbo-hydrate.	Cellulose.	Ash.
Peas	10·6 to 14·2	18·8 to 23·4	1·2 to 1·4	56·2 to 61·1	2·9 to 5·5	2·2 to 3·5
Lentils ...	11·7 to 13·5	20·3 to 24·2	0·5 to 1·4	56·0 to 62·4	2·9 to 3·5	1·9 to 2·6
Haricot beans	10·0 to 20·4	13·8 to 25·1	0·9 to 2·4	52·9 to 60·9	2·4 to 4·2	2·3 to 4·2
French haricots	9·0 to 14·0	17·0 to 22·0	1·1 to 1·9	52·2 to 63·5	2·1 to 6·6	2·2 to 6·5

Lentils are imported from Hungary, Egypt, and other places. They contain 0·2 per cent. of oxide of iron, and some phosphates, but no sulphur.

There is most fat and least nitrogen in Spanish haricots. Egyptian lentils are the richest in nitrogen, and small kinds are richer than large ones. Peas contain the highest proportion of nitrogen before they reach maturity. The nitrogenous or **proteid** substance of this group gives especial value to them as a food. It consists largely of **legumin**, which is not a single substance, but is formed of grains of aleuron, a mixture of globulins, albumoses, and proteoses, oval or spherical in shape, and somewhat larger than starch grains. *Drackendorff*[5] gives the following composition of this substance: Carbon, 51·47 per cent.; hydrogen, 7·02; oxygen, 24·09; nitrogen, 16·82; sulphur, 4·40. Osborne separated from peas[6]—**legumin**, a globulin not coagulated by heat; **vicellin**, another globulin soluble in salt solution, which together form 10 per cent. of peas; **legumelin**, 2 per cent., and two proteoses. The proteids from **dried beans** he found to consist of **phaseolin**, a globulin, which formed 20 per cent. of the seed; and **phaselin**, which is less abundant, together with a trace of proteose. The proteids in lentils are practically the same as in peas. The carbohydrates of the group are starch, dextrin, sugar, gum, lecithin, and cholesterin. The salts[7] are valuable to the body; peas, being taken as the type, contain 27·3 parts per 1,000, including 11·41 per cent. of potash, 0·26 soda, 1·36 lime, 2·17 magnesia, 0·16 ferric oxide, 9·95 phosphoric acid, 0·95 sulphuric acid, and 0·42 chlorine. Their richness in phosphates places them in rivalry with wheat, but as they contain no gluten, they cannot be made alone into bread; and their richness in nitrogen gives them a position parallel with meat, but the vegetable proteids are not so easily attacked and converted into peptones as proteids of animal origin.

Peas have more or less oval starch grains, with a central hilum or longitudinal cleft extending nearly the length of the grain. In beans the starch grains are somewhat larger and flattened, and the longitudinal cleft is crossed by transverse fissures. Lentils are richer in iron than peas, and have an advantage over them in the fact that they do not generate

sulphuretted hydrogen in the intestine. Fine flour made of lentils, rye, and oatmeal together, is an admirable food for invalids.

Ground-nuts, *Arachis hypogæa*, N.O. Leguminosæ. A plant growing in warm countries, as South France, South America, China, etc., which bears subterranean pods containing two or four seeds the size of a hazel-nut; sometimes called the earth-almond. The root resembles liquorice, and is sometimes sold for it. The nuts form a highly nutritious article of food, which, according to Corenwinder,[8] contains: Water, 6·76 per cent.; oil, 51·75; nitrogenous matters, 21·80; non-nitrogenous, including starch, 17 66; salts, 2·03 (including phosphoric acid, 0·64; potassium, magnesium and chlorine, 1·39 per cent.).

Ground-nut is a name also applied to *Apios tuberosa*, another leguminous plant, having a tuberous root of pleasant taste; while the name of earth-nut is applied to the umbelliferous plants *Bunium flexuosum et bulbocastanum*, which grow in the woods of Britain, and have a tuber or nut of about the size of a chestnut, which has a sweet and farinaceous taste. They grow at the end of a slender root about 4 or 6 inches below the surface. These are all used like potatoes.

Mushrooms belong to the N.O. Hymenomycetes, subclass Basidiomycetes, of the class Fungi. The common mushroom, and its cultivated variety, is the *Agaricus campestris*, found in pastures and open spaces. They are used as a vegetable, and to make ketchup and sauce. Other good species are *A. georgii* and *A. primulus*, the latter being regarded by connoisseurs as the most delicious. The young mushroom consists of a small round spherical button of a white or fawn colour fixed on a solid stalk. As it grows the head expands, and the under surface changes colour with its expansion, being at first pink, but gradually changing to a liver, dark brown, or black colour. Their flesh is white and of compact and brittle texture. A fresh, tender mushroom is easy of digestion, tasty, appetizing, of delicious flavour and odour, and an excellent adjunct to other foods; but not highly nutritious, or to be compared in value with essential foods like milk or eggs.

Kohlransch[9] gave the following composition of various edible fungi:

Name.	In 100 Parts of Dried Substance.				In 100 Parts of Ash.	
	Protein.	Unfermentable Sugar.	Mannite.	Fat.	Potash.	Phosphoric Acid.
Agaricus campestris	20·63	7·13	4·91	1·75	50·71	15·43
Cantharellus cibarius	10·68	—	23·43	1·38	48·75	31·32
Boletus edulis ...	22·82	—	5·14	1·98	50·95	20·12
Clavaria flavia ...	24·43	—	4·81	12·13	51·47	35·07
Tuber cibarium ...	36·32	—	—	2·48	55·97	30·85
Helvella esculenta ...	26·31	—	—	2·3	—	—
Morchella esculenta	35·18	—	—	—	—	—
Morchella conica ...	29·64	—	—	—	—	—

The large proportion of nitrogenous substances in mushrooms and other edible fungi suggested the name of *vegetable beef-steak* for them, but Mendel has shown that they only resemble beef in the proportion of water they contain. According to him, only one-half of the nitrogenous material in them is available for nutriment, the proteid substances being small in amount — about 2·5 per cent. Mendel,[10] however, agrees with other analysts that they are rich in carbohydrate food and potash salts, but that the name of vegetable beef-steak is inapplicable to them, that they are of little more value than other vegetables, and that as proteid-providers or flesh-formers they are not comparable with peas and beans.[11]

Chanterelle (*Cantharellus cibarius*) is one of the best edible fungi of France and Southern Europe. It is allied to *Agaricus campestris*, and has a rich yellow colour and fruity smell.

Boletus (*Boletus edulis*) is an extensive genus of fungi found in meadows and woods, especially pine-woods. The cap contains[12] much carbohydrate material (mannitol, 3·97 per cent.; trehalose, 4·06; and glucose, 0·37) and a small amount of proteid. Several species are eaten on the Continent.

Fistulina hepatica is a fungus allied to Boletus, which grows on oak, ash, beech, and other trees. It is eaten in many places. When broiled it furnishes its own sauce, and is scarcely distinguishable from meat, and has been called the 'beef-steak fungus.'

Other edible fungi are: The *Agaricus ulmaris*, which grows on elm-trees; the *A. ostrealis*, or oyster mushroom, which has a

lateral stem, and is perfectly wholesome when gathered and cooked young; the *A. gamlosus*, or St. George's mushroom, which grows in pastures in May and June; the fairy-ring champignon, or *Morasmius oridedes*, a delicious fungus growing in rings in pastures; the *Coprimus comatus*, or maned mushroom, which grows by the roadside and in other places—when young and cylindrical, and having white or pinkish gills—is highly commended; the *Lactuarius deliciosus*, or milky agaric (which assumes a livid green when bruised or broken, and whose juice is saffron coloured, but becomes greenish on exposure to the air), is delicious; and *Lycoperdon giganteum*, or the puff-ball, which grows in pastures or hedge-banks in fields, is edible when young and juicy, but old ones are tough and leathery.

Care must be taken in the selection of mushrooms found growing wild, as many unfortunate accidents have occurred through the consumption of poisonous varieties. Cooks have various ways of testing their innocence. Thus, a silver spoon or fork used to turn them during cooking is not affected by edible fungi, but the acrid juice of poisonous ones will blacken or corrode the metal. Another method used by the cook is to sprinkle the under surface of the fungi with salt before cooking them. The salt abstracts some of the juice, which colours it yellow or red if they are poisonous, but only turns it dark or black if they are innocent and edible.

Poisonous mushrooms, among which are *Agaricus muscarius* and *Lactuarius torminosus*, may, however, usually be known by their appearance, taste, and the situation in which they have grown: (*a*) Their colour is pale yellow, sulphur, bright red, blood red, or greenish, or they turn blue or moist when cut; their cap or *pileus* may be warty. (*b*) They have a bitter, burning, astringent, or otherwise disagreeable taste and unpleasant odour. (*c*) They are found in woods or moist, marshy places, in caves, underground passages, on refuse or stumps of trees. Species which are perfectly harmless when grown in pasture-land may become exceedingly poisonous if they grow near decomposing animal or vegetable substances or stagnant water. Many fungi are eaten all over the world with impunity; but some are eaten safely in France which are considered poisonous in England, and others eaten in Russia and Prussia are never eaten in France. All

kinds are poisonous to some people, but others are doubtful. One person may eat them with impunity, but others may not. The smallest piece will occasion violent poisonous symptoms in a person of peculiar idiosyncrasy. It is quite true that freshness and cooking influence their toxicity. They contain a principle which is more or less dissipated by heat, and is partly removed by peeling and washing them in boiling water or vinegar. They should never be eaten except they be fresh. A dish of mushrooms may be quite innocent if eaten as soon as they are cooked; but if they be eaten four or six hours afterwards poisonous symptoms may follow, owing to the development of ptomaines by bacterial action. *Harnack*[13] says they contain two active ingredients: one is **Muscarin** ($C_5H_{13}NO_2$), which is the active volatile principle largely dissipated by cooking. It causes irritant symptoms, such as pain, vomiting, and purging. A small quantity of muscarin introduced into the circulation or applied directly to the heart causes the cardiac action to become slow and feeble, and will stop it if the dose be sufficient. The other principle is an alkaloid called amanitine ($C_5H_{13}NO_3$), which causes narcotic symptoms, as headache, giddiness, confusion of the mind, illusions, delirium, or convulsions. The same fungus has been known to cause irritant symptoms in one person and narcotic ones in another, and a combination of the two in a third. If the sufferer is not relieved by the removal of the fungus by free purging and vomiting, or by giving anodynes and stimulants, death may take place in two or three days. But if it is remembered that edible mushrooms are found in closely-fed pastures, and seldom in woods, there will be less danger of getting the poisonous ones.

The **Morel** (*Morchella esculenta*), subclass Ascomycetes (Fungi), has a hollow stalk and roundish or conical cap or *pileus*, somewhat pitted. There are several varieties; the common morel grows plentifully in some parts of Britain, but they are mostly imported from Germany. They are used to flavour gravies or as an accompaniment to other dishes, and may be made into ketchup. They contain 3·4 per cent. of proteid, are rich in potash salts and phosphates, and are of about the same nutritive value as mushrooms.

The **Truffle** (*Tuber cibarium, æstivum et brumale*), subclass

Ascomycetes (Fungi). There are black, red, and white varieties, the black being in highest repute, and are much used for seasoning gravy and soup and for garnishing dishes. They contain a large percentage of nitrogenous material—8·9 per cent.—and, like mushrooms, have been esteemed to approach animal food in their nature, especially as they are stimulating and heating. They are light and elastic, and have an agreeable perfume, which is lost by keeping. They should only be partaken of in moderation, as their wholesomeness is doubtful, and persons with a weak stomach digest them with difficulty.

Many species of **Algæ**, which are composed almost entirely of cellular tissue, are edible and nutritious, as dulse and carrageen. Dulse is *Rhodomenia palmata*, a seaweed largely used for soup and jelly in Eastern countries. One species furnishes the agar-agar of China. Carrageen, also called Irish moss, is a seaweed on various coasts. It is dried for making soup and jelly, and has been made into bread for diabetes.

SALADS AND PICKLES.

Salads are composed of raw vegetables, many kinds being mingled together and dressed with condiments, such as vinegar, salad oil, and spices. Salads are valuable as food mainly for the freshness of the vegetables composing them, for their juices, containing valuable salts, and the iron in connection with the chlorophyll. They are cooling, appetizing, and antiscorbutic. They sometimes cause indigestion, because of the large quantity of indigestible cellulose in them, and many people require the addition of vinegar or other condiment to aid their digestion. The bulk of salads consists of lettuce, to which is added tomatoes, onions, endive, radishes, cresses, cucumber, beetroot, etc. Most of the Cruciferæ contain allyl sulphide, which is specially abundant, however, in garlic.

Pickles consist of onions, cauliflower, red or white cabbage, cucumber, French beans, or other vegetables preserved with vinegar and spices. Like all vegetables, they are antiscorbutic, but many of them are hard of digestion, and without the help of good mastication and the stimulation of the stomach by the combined aromatic spices they might be quite indigestible. **Onions**

have already been considered. **Cabbage** has also had a share of attention. The variety most used for pickle is red cabbage, but white cabbage should not be despised at a time when salads are scarce. The crisp whiteheart cabbage, finely cut into shreds and mingled with other ingredients, will supply a salad throughout the winter when other materials are scarce. **Sauer-kraut** is a preparation of cabbage-leaves, subjected to pressure and allowed to ferment. **Beet-root** is also a very agreeable salad or pickle; but when eaten very freely it is said to be injurious to the stomach.

Celery is the umbelliferous plant *Apium graveolens*, which grows wild in damp and marshy places. It has, however, been extensively cultivated, and careful selection and natural development have produced several edible varieties. The stems or leaf-stalks are readily blanched by covering them with earth, when they become mild and crisp, and form a most useful and wholesome salad. It is also stewed, especially the turnip - rooted variety, as a vegetable to be eaten with white sauce and meat. The entire plant, including the seeds, may be used freely to flavour stews and soup. It is stimulant, carminative, nervine, aphrodisiac, and diuretic, and has been especially recommended for persons suffering from rheumatism. The odoriferous principles of the plant are sedanolide and an anhydride of sedanonic acid contained in the oil of celery.[14]

Cardoon (*Cynara cardunculus*) much resembles artichokes, and belongs to the same species. The stem and leaves, like celery, are blanched and rendered mild and crisp by banking with earth. It is eaten as a salad or vegetable, and to flavour soup, in all the countries along the Mediterranean.

Endive, *Cichorium endivia*, N.O. Compositæ; when eaten as a salad, it is good for the liver, indigestion, and similar complaints.

Cresses: Nasturtium, N.O. Cruciferæ. There are two or three British species, of which water-cress (*Nasturtium officinale*) is the most important. It grows in rivulets, clear ponds, and ditches, and is extensively cultivated. The leaves have a moderately pungent taste, but are greatly esteemed as salad for their valuable antiscorbutic properties. *Nasturtium* is the popular name for *Tropæolum majus*, or Indian cress, an annual grown in gardens

chiefly for its flowers. Like water-cress, the leaves have a pungent taste, and are used for salad. The fruit is also used for salad, pickles, and as a substitute for capers. Other cresses are Senebiera, Lepidium, and pennycress or Thlaspi, all cruciferous plants, which are valuable antiscorbutic salads. Many of these contain allyl sulphide, and the nasturtium contains an oil which consists of 85 per cent. of benzyl thiocarbamide.[15]

Capers, the buds of *Capparis spinosa*, the caper-bush, N.O. Capparidaceæ. They are much used in salads, sauces, and pickles, and also very agreeable as an accompaniment of boiled mutton. The plant is cultivated largely in France and Italy, where capers are of commercial value. It also grows wild on old walls, in the fissures of rocks, etc., in countries bordering on the Mediterranean. The fresh buds are gathered every morning before the flowers expand, and are pickled in vinegar. The flower-buds of marsh-marigold and fruit of tropæolum are sometimes pickled and used as a substitute for capers.

Dandelion: The young and tender leaves of *Taraxacum officinale*, N.O. Compositæ, are used as a salad, and are highly prized by some people. They are sometimes mixed with the leaves of sorrel (*Rumex acetelosa*, N.O. Polygonaceæ), and the same two leaves, cooked together like spinach, form an agreeable accompaniment to pork, veal, or duck. They are stomachic, mildly laxative, and indirectly increase the action of the liver and kidneys. Sorrel contains much free acid, especially oxalic acid, and oxalates of calcium and potassium, which are prejudicial to persons with gout, gravel, or stone.

Lettuce, *Lactuca sativa*, N.O. Compositæ; several varieties and above fifty species are grown, of which cos lettuce and cabbage lettuce are the best. It is a cooling summer vegetable, chiefly valued for the juice and salts contained in it, which render it one of our most highly esteemed salads. The young plant contains an abundance of milky and pellucid juice, which is bland and almost tasteless. That of the mature plant is bitter and astringent, and has undoubted anodyne and soporific qualities, due to **lactucic acid**. This is an alkaloid in the form of flat needles, which holds a place between hyoscyamus and opium, but has not so powerful an effect as either of those drugs. It is to

this alkaloid that the juice of the lettuce owes its sedative effect, which renders it useful for soothing the cough in consumption and chronic bronchitis, and to induce sleep where only a mild soporific is required. As a vegetable it is chiefly cooling and antiscorbutic.

Cucumber, *Cucumis sativa*, N.O. Cucurbitaceæ ; extensively cultivated, and highly prized as a salad. The young, immature fruit are called **gherkins**, and are used for pickle. Cucumbers are neither nutritive nor very digestible ; but they contain an abundance of fluids and vegetable salts, and are cooling and refreshing.

Radish, *Raphanus sativus*, N.O. Cruciferæ ; several varieties are eaten as a salad. Some have a fine flavour, and are tender and crisp when young ; others contain much fibrous material, which makes them hard to digest. They are somewhat stimulating to the stomach, promoting a flow of saliva and gastric juice, and by their pungency and warmth encourage appetite.

Samphire or **Crithmum**, also called sea-fennel, N.O. Umbelliferæ ; grows on rocks at the seashore ; has a spicy aromatic flavour. Soaked in vinegar it makes an admirable pickle.

REFERENCES : [1] Watts' 'Dict. Chem.' [2] *Compt. Rendus*, 1897, 125. [3] *Loc. cit.* 119. [4] *Ibid.*, 1898, 127. [5] Drachendorff's 'Plant Analysis.' [6] *Jour. Amer. Chem. Soc.*, xx., 348. [7] Blyth's 'Foods.' [8] 'Year-book of Pharmacy,' 1874, 35. [9] *Ibid.*, 1878, 371. [10] *Am. Jour. Physiol.*, 1878, i., 225. [11] The *Lancet*, March 12, 1902. [12] Bourquelot, *Jour. Chem. Soc.*, April, 1902. [13] 'Year-book of Pharmacy,' 1877, 142. [14] Ciamician, *Jour. Chem. Soc.*, Abstracts, 1897, 483. [15] Gademer, *Archiv der Pharm.*, ccxxxviii., 111. [16] Mitchell Bruce's 'Materia Medica.'

CHAPTER XV

CONDIMENTS AND SPICES

THE proper use of condiments and spices is an important acquisition of the cook, for they are used largely in culinary art. Spices and condiments of almost every name contain aromatic oils and substances of extremely complex and variable composition, to which their properties are due. Opinions differ as to the propriety of their use, but the majority of medical men are in favour of their consumption in *moderation*, while they

urge against their *abuse* that they may cause chronic congestion of the liver from hyperæmia, and chronic catarrh of the stomach. It should be thoroughly understood that they are not foods in the proper sense, but adjuncts to food. When properly used they arouse a flagging appetite, excite the gastric mucous membrane to secretion, and stimulate the torpid movements of the stomach and bowels. These properties show them to be suited to the middle-aged, the aged, and the feeble; *healthy individuals with normal digestion do not need them, and they should most certainly be withheld from children.*

There are several groups which may to some extent be considered together: Mustard, pepper, horse-radish, ginger, cayenne pepper, allspice; cloves, nutmeg, mace, caraway, aniseed, cinnamon; and mints, as thyme, sage, mint, marjoram; parsley, fennel, juniper; vinegar; sugar, honey.

The aromatic substance to which their effect is chiefly due is, in many of them, closely allied to phenol on the one hand, and to the resins and balsams on the other. In thyme, mint, sage, we have a concrete body, or **stearoptene**, having a similar action to camphor and turpentine; others owe their chief properties to volatile oil, as mustard and horse-radish, which is formed by the decomposition of another body under the influence of an enzyme.

Most condiments and spices are excellent antiseptics, and by their aromatic and sedative action they subdue any irritability of the stomach and bowels, and the sensation of warmth which they create relieves dyspepsia, cramp, spasms, hiccough; the same influence is extended over the intestinal tract, local secretions being promoted, flatus expelled or absorbed, the pain, colic, or the griping tendency of many of our vegetables prevented or relieved. By their presence in our food they excite the nerves of taste and smell and a sense of hunger, thereby directly increasing appetite and desire for and enjoyment of food; saliva and gastric secretion are increased in quantity, the churning movement of the stomach promoted, and digestion in general assisted.

Mustard.—White mustard, *Sinapis alba vel Brassica alba;* black mustard, *S. nigra vel B. nigra*, N.O. Cruciferæ. Mustard of commerce consists of white or black mustard seeds, or both together, ground to a fine powder, and passed through a sieve to remove husks; the latter are then used to obtain the fixed oil by

pressure. Mustard is a greenish-yellow powder, without smell when it is dry, but when moist having a pungent taste and penetrating odour which is irritating to the nose and eyes. Mustard is the most familiar of all condiments ; it produces a sensation of warmth in the mouth and stomach, augments the digestive secretions by increasing the circulation in the bloodvessels of the alimentary canal, increases appetite and desire for food, and assists in its digestion. The general remarks on the condiments may be fully applied to this as typical of the group ; it is, in short, an appetizer and aid to digestion, especially when taken with meat or fatty food, and is a disinfectant and deodorizer of the alimentary canal. The essential oil of mustard is used as a liniment for lumbago, sciatica, rheumatism, or other complaint requiring a warm stimulating remedy ; and a mustard poultice, or *sinapism*, is very useful to check vomiting, relieve pain, and as a counter-irritant.

Dr. Hassall[1] found the composition of black and white mustard to be as follows :

(*a*) *Brown Farina.*—Water, 4·8 per cent. ; fixed oil, 35·7 ; myronic acid with potassium, 4·8 ; myrosin and albumin, 29·5 ; acrid salt, 3·5 ; cellulose, 16·8 ; ash, 4·7.

(*b*) *White Farina.*—Water, 5·3 per cent. ; fixed oil, 37·7 ; myronic acid, nil ; myrosin and albumin, 27·4 ; acrid salt, 10·9 ; cellulose, 16·5 ; ash, 4·11.

The **fixed oil** is the same in both varieties, yellow, of mild taste, and consists of stearic, oleic, erucic, sinapolic, and behinic acids in combination with a glyceryl radicle, and varies from 20 to 25 or even 35 per cent. The essential or *volatile oil* does not exist ready made in mustard, but is generated when the meal is moistened under the influence of **myrosin**, which is an enzyme similar to emulsin in almonds, and occurs in both kinds of mustard.

The active principle of black mustard is **sinigrin**, or potassium myronate ($C_{10}H_{18}KNS_2O_4$), which is soluble in water and warm alcohol, and crystallizes in rhombic prisms. The combination of this substance with water and myrosin results in the production of glucose, potassium acid sulphate, an *alkaloid* sinapine sulphocyanate ($C_{16}H_{24}NO_5CNS$), and a *volatile oil* which is allyl isosulphocyanate ($C_3H_5N{:}CS$).

The active principle of white mustard is **sinalbin**, a glucoside ($C_{30}H_{44}N_4S_2O_{18}$), which, under the influence of myrosin and moisture, develops into glucose and the same alkaloid as in the black variety, also sinapine sulphate ($C_{16}H_{25}NSO_9$), and an essential or volatile oil bearing the name[2] of ortho-hydroxyl-benzyl sulphocyanate $C_6H_4\left\langle\begin{matrix}OH\\CH_2NS\end{matrix}\right.$. The volatile oils are almost colourless, pale yellow fluids, readily soluble in ether and alcohol, but sparingly soluble in water.

The most active mustard is prepared from a mixture of black and white seeds, because what is deficient in one is in excess in the other kind, and a perfect mustard containing the greatest amount of the active essential oil is thus obtained. Table mustard is adulterated with many things, with the purpose of diluting the mustard or modifying its character. Starch, wheat flour, fine oatmeal, pea flour, linseed meal, rape seed, and sometimes plaster of Paris and clay, have been used as diluents; turmeric, gamboge, ochre, and aniline colours or methyl orange, to give a yellow colour; horse-radish, ginger, cayenne or other pepper, to give pungency and heat to the mixture; and malt flour has been added with the view of mixing in it a diastatic ferment as a digestant of the carbohydrates.

Horse-radish, *Cochlearia armoracia*, N.O. Cruciferæ, contains a volatile oil or sulphocyanate of butyl (C_4H_9CNS), allied to that of mustard, and, like it, is only developed by the decomposition of a more complex body by the influence of an enzyme existing in the root ready for action. Horse-radish has a pungent odour and warm taste; it is highly stimulating to the alimentary functions; promotes appetite and salivation, increases gastric secretion and movements, and is a carminative and antiseptic all along the canal. The sauce is a valuable aid to the digestion of meat and other rich food. Containing a large proportion of sulphur and valuable salts, it has excellent antiscorbutic properties, and is useful in the treatment of atonic dyspepsia, and as a stimulant in general debility, chronic rheumatism, sciatica, nervous diseases, and is even of value in dropsical conditions.

Pepper.—The dried immature fruit of one of the pepperworts, N.O. Piperaceæ. The species are numerous, grow in the tropics, and are of commercial value.

Black Pepper is the dried unripe berry of *Piper nigrum*, largely imported from Molucca, Borneo, Sumatra, and Java, and bears various commercial names. These kinds vary in quality, Malabar being the best and dearest. Household pepper mostly consists of equal quantities of Malabar to give flavour, Penang to give strength, and Sumatra berries to give colour,[3] mixed, and ground in a mill. The berries or drupes grow in clusters of twenty to fifty, on a plant 8 to 12 feet high; they are smooth, and the colour is first green and then bright red; they are pulled by hand before they are ripe, and become black, shrivelled, and wrinkled, by drying in the sun. The differences between the berries from various districts are recognisable by those who deal in them when seen separately, but if they are mixed together it is almost impossible to separate and name them correctly.

White Pepper is the ripe fruit of the same plant, and owes its colour to its treatment. The finest berries are used; they are soaked in water to loosen the outer rind, or **pericarp**, which is then rubbed off, and the berries are afterwards blanched and dried in the sun. By the removal of the pericarp white pepper is milder than black, but otherwise possesses the same constituents and properties.

Pepper has a pungent, aromatic odour and taste; it contains 5 to 9 per cent. of piperine, about 1 per cent. of volatile oil, an acrid resin, albumin, starch, gum, and salts. **Piperine** is a crystalline alkaloid ($C_{17}H_{19}NO_3$) which yields **piperidin** and **piperic acid**; the proportion varies in different species. It is contained in most of the pepperworts, black pepper, long pepper, cubebs, and allspice. It can be obtained, and its percentage ascertained, by mixing finely-powdered pepper with twice as much slaked lime, making it into a paste with water, and boiling it for fifteen minutes. It is then evaporated to dryness on a water-bath, the residue powdered and exhausted with ether, from which the *piperine* is obtained by evaporating the ether, washing with alcohol, and crystallizing.

Pepper is adulterated with various substances, as horse-radish, mustard, chillies, and other spices, and also with other substances which contain no piperin. J. W. Gladhill[4] gives the following analysis of commercial peppers:

	Ash.	Ethereal Extract.	Piperine.	Oleo-resin.
Black :				
Singapore	3·5–4·5	8·76– 9·76	6·58–7·68	1·08–2·6
Tellicherry	3·8 4·8	7·26– 8·85	5·91–6·82	0·70–2·8
Allippy	4·7 4·8	9·47– 9·65	6·75–7·50	1·95–2·72
Trang	3·8–3·9	8·44– 8·83	5·12–5·61	3·22–3·32
Lienburg	3·6 -4·0	8·70– 9·48	5·98-6·59	2·20–3·20
Lampong	5·0–5·5	8·76–10·61	7·00–8·30	1·16–2·30
Sumatra W.C.	4·0–4·3	9·22– 9·28	6·68–7·00	2·28–2·54
Acheen	4·0–4·7	9·20–10·10	7·10-7·96	2·10–2·50
White :				
Coriander	0·8 -1·0	7·90–11·68	6·81–9·00	1·06–2·68
Singapore	1·0–1·2	8·20– 8·78	6·78–7·26	1·00–1·67
Penang	2·1–2·8	6·80– 7·20	5·74–6·76	0·44–1·30
Decorticated	0·8–1·9	6·60– 7·64	6·25–7·64	0·24–1·39
Hulls, for adulteration ...	7·0–1·9	5·00– 8·93	none	5·00–8·93

Long Pepper is *Piper longum*, a native of Bengal, Malabar, and Java, whence it is imported. The fruit is gathered while green and dried in the sun. Other kinds of pepper are allspice or pimento, and cubebs, or *Piper cubeba.*

The whole family of Pepperworts have an aromatic, pungent, hot taste in proportion to the amount of piperine and volatile oil contained in them, which pervades the entire plant, but is especially abundant in the fruit. They are aromatic stimulants which act upon the salivary and gastric glands and encourage a free secretion by them, and aid digestion in the same way as other condiments. They are useful carminatives, and were also used formerly in feverish conditions, especially malaria. The active ingredients are excreted by the kidneys, and in passing out of the body they stimulate the mucous membrane of the urinary tract and disinfect it.[5] They are attributed with a similar influence over the mucous membrane and bloodvessels of the lower bowel, and they are used frequently in the treatment of hæmorrhoids, anal fissure, and similar ailments.

Cayenne Pepper, the powdered fruit or pods of various species of Capsicum, N.O. Solanaceæ. The fruit varies in size in different varieties, from a small berry or pod to large berries or pods as big as a plum. *Capsicum annum* bears the fruit called chillies ; *C. baccatum* is the berry-bearing capsicum, or bird-pepper ;

C. fructosum, or goat-pepper, is much hotter than the others; *C. grossum*, or bell-pepper, is an East Indian species with large capsules. They are pickled entire, and the powder or pepper is used for sauce, curry, and as pepper, an ingredient of soup and highly-seasoned animal or vegetable dishes.

The pepper contains **capsicine**, a volatile alkaloid soluble in alcohol; **capsaicin**, an acrid substance; an oleo-resin, and some fatty matter.[6] It is adulterated with horse-radish, turmeric, red ochre, brick-dust, and other matters. In a reasonably small quantity the pepper is a grateful stimulant and carminative, of especial value to alcoholic subjects; it is especially used by residents of hot climates, and is of value to arouse the appetite, dispel flatulence, and relieve dyspeptic symptoms generally.

Cloves are the dried flower-buds of *Eugenia caryophyllus*, N.O. Myrtaceæ, which are grown in and imported from the Moluccas. The plant abounds in a volatile oil—**oil of cloves**—having the pungent, aromatic taste and odour for which the flower-buds are so highly prized. It contains eugenol, furfurol, amyl ketone, methyl benzoate, and methyl alcohol, the eugenol being the most abundant and most important ingredient.[7]

Cloves form a type of the aromatic spices used in culinary art. Their value depends entirely upon the volatile oil. When taken in our food, they excite the nerves of taste and smell and encourage appetite and relish for food. The secretion of the digestive fluids is increased by them, whereby they aid digestion, and a sensation of warmth is produced in the abdomen, to the relief of flatulence, cramp, spasms, and hiccough, and they relieve or prevent griping induced by food or other means. Everywhere they disinfect the alimentary canal. The active principles of cloves, cinnamon, and their allies, enter the blood, and are excreted by the lungs, kidneys, and skin, in passing through which they stimulate and disinfect them. By their stimulation of the visceral circulation and lymphatic glands they encourage leucocytosis, and are therefore a valuable stimulant to the formation of white blood cells. Upon the nervous system they are both stimulating and sedative, increasing thereby the vigour of the heart, relieving pains around it and palpitation, and preventing or removing nervous depression, lowness of spirits, and

hysteria.[8] They should have a wide range of application in dietetics.

Cinnamon is the dried inner bark of *Cinnamomum zeylanicum*, N.O. Lauraceæ, obtained from the shoots of trees grown in Ceylon. It contains tannic acid, sugar, gum, and the official volatile oil. The oil contains cinnamic aldehyde 84 and eugenol 3 per cent., besides phellandrene, methyl-amyl-ketone, pinene, cymene, cymol, and aldehydes.[9] It is a favourite aromatic flavouring of foods, and, like cloves, is a disinfectant, aromatic carminative, and astringent. Used in food, it allays nausea, vomiting, flatulence, and diarrhœa, and is useful in gastric or intestinal catarrh, influenza and catarrh of the respiratory mucous membrane, chronic bronchitis, and phthisis, where its principal action is that of a pleasant disinfectant.

Nutmeg and Mace.—Nutmeg is the dried seed of *Myristica fragrans*, N.O. Myristicaceæ. Mace is the dried covering or net-like envelope which surrounds a nutmeg, and when fresh is a beautiful crimson colour. The growing nutmeg is like a small pear. The fleshy part is yellowish-white externally and pure white internally, and is four or five lines thick. As it ripens the fruit opens longitudinally, showing the arillus or mace of lovely hue surrounding the nut. When ripe the nut drops out and the arillus withers. Though a native of the Isles of Banda, East Indies, it is grown throughout India, Sumatra, Brazil, and the West Indies.

Nutmeg and mace contain 31 to 40 per cent. of fixed concrete oil, 8 or 9 of volatile oil, starch in variable amount, moisture 1 to 5, and ash 5 per cent.[10] The volatile oil consists of a turpene, myristican and myristicol.[11] The fixed oil is chiefly myristicin or myristic acid ($C_{14}H_{28}O_2$), a stearoptene or crystalline substance combined with glycerine to form trimyristicate of glyceryl.[12]

Their use and properties are similar to those of cloves and cinnamon (*q.v.*). They are exceedingly useful in summer diarrhœa, in cramp, spasms, and flatulence, especially when due to hysteria. Nutmeg also has narcotic properties, and is useful in the insomnia and restlessness of delirium tremens.

Ginger, the dried rhizome or root of *Zingiber officinale*, N.O. Zingiberaceæ. It is prepared by washing and scraping, drying and bleaching. It contains an aromatic oil or oleo-resin, which

is a complex mixture of hydrocarbons, together with cymene ($C_{10}H_{14}$), a terpene, aldehydes, and ethereal salts. It has a hot, pungent, aromatic taste and odour, and is a popular agent for flavouring pickles and other foods. The properties are similar to those of cloves and other allies, and, like them, it is useful in diarrhœa, nausea, vomiting, atonic dyspepsia, and enfeebled states of the bowels.

Curry Powder is a mixture of the foregoing condiments. The following is a good example of its composition: Capsicum, 1·5 parts; ginger, 2; black pepper, 3; coriander, 2; cardamom, 0·5; cinnamon, 2; cloves, 1; turmeric, 12. Mix and keep in a bottle.

Garlic, *Allium sativum*, already mentioned with onions. It contains active principles similar to horse-radish, especially allyl sulphide [$(C_3H_5)S$], which render it a valuable general stimulant, tonic to the stomach, and carminative; it is useful for dyspepsia, spasmodic troubles, flatulence, hiccough, hysteria, and chronic catarrh; it quickens the circulation, excites the nervous system, promotes expectoration, and in passing through the skin and kidneys its ingredients act upon them, and promote sweating and increase of urine.

The Sweet-herbs are the mints (garden mint, spear-mint, and other species of Mentha); thyme (*Thymus vulgaris*), sweet marjoram (*Origanum marjorana vel exotica*), sage (*Salvia verbenacea*), basil (*Calamintha arvensis*), sweet basil (*Ocymum basilicum*), and savory (*Satureia hortensis et saturja montana*), all of the N.O. Labiatæ.

Common Mint, garden mint, used largely for sauce and other culinary purposes. Has an oil which contains[13] a stearoptene ($C_{10}H_{20}O$), also a liquid ($C_{10}H_{14}O$) which is isomeric with carvol. Menthol, a similar crystalline stearoptene, and menthene, a terpene, can be obtained from oil of peppermint.

Thyme contains an oil from which[14] are derived cymene or cymol ($C_{10}H_{14}$), thymene ($C_{10}H_{16}$), and thymol ($C_{10}H_{14}$). Thymol is the most important, being a powerful intestinal disinfectant and carminative, somewhat resembling turpentine in its action. An extended analysis of oil of thyme by Labbé yielded the following composition: 15 per cent. of menthene, 21 cymene, 5 linalool, 8 borneol, 17 of a hydrocarbon which differs from pinene, and 4 of a residue which contained a small amount of carvacrol.[15]

Basil, another aromatic herb much used in France, contains an oil which yields pinene, cineol, camphor, and methyl chavicol the latter also yielding anethol and anisinic acid.[16]

Marjoram is a peculiarly fragrant and aromatic herb used in cookery. It contains an oil which consists of turpinene, terpineol, small quantities of acetic and other acids.[17]

Savory contains an oil which consists of 50 per cent. of carvacrol, 20 per cent. of cymene, also a terpene and a phenol which differ slightly from carvacrol.[18]

Sage, *Salvia verbenacea vel officinalis*, contains an oil consisting[19] of 40 per cent. salviol ($C_{10}H_{16}O$), 20 each of two hydrocarbons ($C_{10}H_{16}$), 10 of a camphor ($C_{10}H_{16}O$), 10 of cedrene ($C_{15}H_{24}$), and a little cymene. This powerful oil is an antiseptic to the whole alimentary canal; it is also astringent, and has stimulant and sudorific properties. Sage-tea has been valued as a domestic remedy for feverish colds, sore throats, quinsy, etc. Its value in culinary processes is that it is an antiseptic, and assists in the digestion of fat and luscious foods, as pork, duck, goose, of which it has long been an accompaniment.

Bay-leaf, which is also used for flavouring, contains an oil which yields **myrcene**, a terpene, eugenol, chavicol, phellandrene, and citral.[20]

The sweet-herbs are all used as flavouring agents in cooking and for sauces to animal food; the most delicate being 'mint sauce' as an accompaniment to lamb or mutton. They are all antiseptic, and are proper accompaniments of 'high' or rich food. They have powerful soothing and carminative effects; they likewise are diffusible stimulants, and strengthen the heart without quickening its beat. They act differently from the group of which cloves and cinnamon are a type; for instead of dilating the vessels of the stomach and intestines, and thereby causing an agreeable sensation of warmth, their first effect is to contract the bloodvessels and produce a sensation of cold; and their effect is in proportion to the coldness. The intestinal movements and absorption are checked to some extent, and glandular activity depressed; nevertheless, they are powerful antiseptics, and they soothe griping and relieve colic and flatulence. An essence of sweet-herbs for soup can be made of: Thyme, 4 parts; winter savory, 4; sweet marjoram, 4; sweet

basil, 4; lemon peel grated, 2; shalot, 2; celery seeds, 1; and alcohol, 50. Bruise and macerate in the spirit for seven to ten days; filter.

Caraway Seeds, the fruit of *Carum carui*, N.O. Umbelliferæ. A very agreeable aromatic flavouring and carminative of pleasant taste and aromatic odour used in cookery. The properties are due to an essential oil which contains **caruen** ($C_{10}H_{16}$), a terpene, and **carvol** ($C_{10}H_{14}O$), isomeric with thymol.[21] They are stimulants and aromatics of the same type as cloves and nutmeg.

Aniseeds, the fruit of *Pimpinella anisum*, N.O. Umbelliferæ, have an essential oil, which is likewise obtainable from the fruit of star-anise, *Illicium verum*, N.O. Magnoliaceæ. It crystallizes at 50° to 59° F., and is 80 per cent. a stearoptene **anethol** ($C_{10}H_{12}O$) and 20 per cent. a terpene. The seeds are used in cookery, and owe their sweet taste and aromatic odour to the oil. They have similar properties to cloves, and they are soothing to mucous membranes generally; hence the value of the oil in bronchial and laryngeal affections.

Fennel, *Fœniculum capillaceum*, N.O. Umbelliferæ, has an oil which contains fenchone, dextro-pinene, phellandrene, methyl chavicol, and anethol.[22] Fennel is used green as a sauce for the heavier kinds of fish—*e.g.*, salmon, mackerel. It promotes digestion in the stomach and bowels, and has the same properties as other aromatics.

Parsley, *Petroselinum sativum*, N.O. Umbelliferæ, contains **apiin**, a substance which is extracted by water, gelatinizes on boiling, dissolves in and crystallizes from alcohol. The seeds contain apiol and oil of parsley. The oil consists of a substance analogous to myristicin, and small quantities of **apiolic acid**, tetra-methyl-apional, and tri-methyl-gallic acid.[23] The properties of the plant are chiefly due to the oil. Apiol is said to predominate in German, myristicin in French parsley. Its main use is as a sauce, but, like many other aromatics, it is scarcely eaten in sufficient quantity with food to produce its specific effects, unless it is taken persistently, when it may be useful for young girls with scanty menstruation and dysmenorrhœa, as a diuretic in kidney troubles, gravel or dysuria, and for malarial fevers or their subsequent effects.

Juniper, the berries of *Juniperus communis*, N.O. Coniferæ, is

one of the flavourings used in the manufacture of gin. Donath[24] gives the following analysis: Water, 29·44 per cent.; organic acids, 3·01; volatile oil, 0·91; resins, 10·39; pectin, 0·73; juniperin, 0·37; albumin, 4·45; sugar, 29·65; cellulose, 15·83; mineral, 2·33. The acids are formic, acetic, malic, and oxalic, alone or in combination with bases. The resins are—one of a green colour which separates out of an ethereal solution, and one of a brown colour which separates from an alcoholic solution. **The essential oil** contains several hydrocarbons, and yields a white crystalline compound. It is volatile, and has a warm aromatic taste and characteristic odour; it resembles turpentine in action, being absorbed into the blood and excreted by the kidneys, which it markedly stimulates; it increases both the solids and water of the urine, and is thereby useful in dropsy due to heart or liver disease, and in some cases of Bright's disease (see 'Gin').

VINEGAR, *Acetum*, is defined as an acid liquid prepared from a mixture of malted and unmalted grain by the acetous fermentation. The specific gravity = 1·017 to 1·019, and it should contain about 5 per cent. of acetic acid ($C_2H_4O_2$). This is **malt vinegar.** It is of decidedly brown colour, and has a distinct flavour and aroma. An analysis[25] of four samples showed it to contain 4·86 to 6·61 per cent. of acetic acid, 2·31 to 3·96 of total solids, 0·34 to 0·55 of ash, 0·59 to 0·75 of albuminoids, and 0·05 to 0·09 of phosphoric acid. Many vinegars are made from beet-root, sugar, wood, rice, maize, and glucose, with just a little malt thrown in, and only by courtesy can be called *malt* vinegar. Such samples contain 3·5 to 5·8 per cent. of acetic acid, 0·10 to 2·9 of solids, 0·04 to 0·43 of ash, 0.08 to 0·65 of albuminoids, and 0 to 0·02 of phosphoric acid. The principal adulterations in vinegar are water, sulphuric acid, pyro-ligneous acid, excess of acetic acid, grains of paradise and chillies. Weak vinegar is brought up to strength by adding acetic acid, which is an adulteration, because the acetic acid in vinegar should arise from fermentation and not as a chemical product. The law allows 1 per 1,000 of sulphuric acid. The Society of Analysts adopted 3 per cent. as the minimum of acetic acid, by which they mean *real* acetic acid ($C_2H_4O_2$), and not acetic anhydride ($C_4H_6O_3$). The British Pharmacopœia states that it should contain 5·4 per cent. of real acetic acid. In the

United States 4·6 per cent. is the standard, in Germany 6, Austria 6, France 8 to 9, Belgium 5·6, Russia 5.

The acetous fermentation occurs from the action of *Mycoderma aceti* in any saccharine fluid, the sugar being first inverted and then converted to acetic acid. The fungus exists in the atmosphere, and readily gains access to the fluid. In the manufacture of vinegar some 'mother of vinegar,' which is a pure mass of the fungus, is added to the liquid, and the process is thereby hastened. A vat is used with perforated sides and lid, and the two discs are fitted into it. Between the latter are placed shavings of beech or other wood moistened with vinegar, in order that they may be coated with the fungus. The liquid containing nutriment for the fungus is poured over it, and slowly trickles through the shavings. The same liquid is poured through several times. It is kept at a temperature of 25° to 40° C., and attains an acidity of about 4 to 6 per cent.

White wine vinegar contains 6 or 7 per cent. of acetic acid, some cream of tartar, and an odour of the wine. It is a splendid condiment, and should not be used for pickling, as its distinctive character is then destroyed. It is usually made from wine containing less than 10 per cent. of alcohol. The *Mycoderma aceti* consumes the nitrogenous and mineral substances of the wine, and causes oxidation of the alcohol, whereby it is converted to acetic acid. There are many substitutes made from the juice of grapes, currants, gooseberries, or merely a mixture of acetic acid and malt vinegar or diluted acetic acid, which are not comparable to the real article.[26]

Other vinegars are made from beer, cider, crab, tarragon, etc. Vinegar is used for many culinary purposes, especially for pickles, salads, and sauces, to which it adds its components, and aids in the general effect as an appetizer and aid to digestion.

SUGAR, cane-sugar or saccharose ($C_{12}H_{22}O_{11}$); the ordinary sugar of commerce is a sweet granular substance, and one of the most nutritious and wholesome materials which the vegetable kingdom affords. Sugar was only known vaguely to the ancients of Greece and Rome. It was introduced into Europe in the time of the Crusades, and became common about the sixteenth century. It is scattered widely over the vegetable kingdom in small portions, but exists largely in the sugar-cane, varieties of beet-

root, parsnip, sorghum, the maple and birch trees. **Loaf-sugar** is chemically pure, and the most concentrated food known to commerce. It contains, besides sugar, a small percentage of sodium and potassium carbonates derived from the decomposition of the malates, oxalates, and citrates of the plant, and lime, magnesia, iron, and alumina. **Raw sugar** is often artificially coloured with Bismarck brown or acid yellow to give it the appearance of genuine Demerara or West Indian crystals. It is also mixed with glucose, sugar of milk, dextrin, starch, sand, plaster, chalk or clay, and flour. Insoluble matters can be removed by solution of the sugar and filtration, and recognised by microscopical examination; the other materials are recognised by chemical tests.

Cane-sugar was formerly chiefly obtained from the sugar-cane, *Saccharum officinarum*, N.O. Graminaceæ, grown in the West Indies, Brazil, British Guiana, Java, and other places. In its manufacture the juice is expressed from the cane between the rollers of a mill or in a hydraulic press, and received into vessels in which it is boiled. Boiling concentrates the juice and destroys any deleterious contamination which may have entered it. Lime is added to neutralize any acidity, and also serves to separate gross impurities, which rise as a scum to the surface and are removed. The concentrated syrup is run off into large vessels to cool and crystallize, and a hole in the vessel allows the uncrystallizable treacle or **molasses** to drain away. What is left behind is the crystallized raw sugar, or **muscavado.** To make white or refined sugar, the raw material is dissolved in water and filtered through cotton bags and charcoal. It is then boiled afresh and poured into vessels in which it again crystallizes, and is now lump or loaf sugar.

Maple-sugar is obtained from the sap of the maple-tree, *Acer saccharinum*, N.O. Sapindaceæ. It is made largely in Canada and America, in the spring of each year, the ascending sap being richest in sugar. The trees are tapped by boring holes in the trunk, and the sap is collected in vessels placed to receive it. It is boiled on the spot, concentrated, crystallized, and refined as before. An ordinary-sized maple will yield 15 to 30 gallons of sap, containing 1 to 2 per cent. of crystallizable sugar, and an uncrystallizable portion called maple-honey.

Beet-sugar is obtained from *Beta vulgaris*, var. *Altissima*, the common beet-root, N.O. Chenopodiaceæ, which yields 12 to 20 per cent. of sugar. It is also contained in parsnips and other roots. The manufacture of beet-sugar was begun during the French Revolution, 'necessity being the mother of invention,' owing to the fact that cane-sugar could not be obtained from the British colonies because of the war. Since then beet-sugar has become an important article of commerce in France, Germany, Austria, and Russia, its comparative cheapness having done much to drive cane-sugar out of the market.

Sugar is an exceedingly valuable article of diet, almost never absent from our table in some form. It cannot be surpassed as a means of providing force or energy, but it is solely a carbohydrate food. Whatever is not immediately used for the purpose of supplying heat and energy to the body may be stored up as fat in the tissues thereof. Jam and preserve consist largely of sugar with the vegetable salts and acids of fruit, and are of great value for children to supply them with food which will be quickly absorbed and transformed into heat by oxidation, without further digestion and elaboration. An excess of sugar is no more good than an excess of any other article of diet. On the contrary, it causes thirst, and in many cases catarrh of the stomach. In the latter instance it is deleterious by promoting a free discharge of mucus from the gastric glands, which surrounds the particles of food and hinders digestion. The peptonization of food is consequently rendered difficult and delayed. Such is the effect of eating an excess of sugar in the form of sweetmeats and confectionery.

Sweetmeats and confectionery consist chiefly of cane-sugar combined with various flavouring essences and ethers, and colouring matter. By careful heating, various colours, ranging from pure white to straw, fawn, brown, reddish, or black, can be given to sugar.[27] Heated to about 400° F., it changes to caramel, which is used to give a brown colour of various shades; other colours are due to agents mentioned below. Sweets may have a definite composition, as aniseed balls and peppermint lozenges, the latter consisting of sugar, albumin, and oil of peppermint. But a great many consist of sugar, boiled or otherwise, acidulated with citric or tartaric acid, and mixed with gum, glucose, tragacanth, gelatine, fatty or other matters, to give consistence to the

mass. **Toffee** consists of sugar and butter boiled together. **Candy** is simple sugar, coloured yellow, red, or white, and crystallized in a particular way. **Marzipan**[28] is made from 2 parts of moist pounded almonds and 1 part of sugar, and contains 50 per cent. of almond, 33·3 of sugar, and 16·7 of water. **Chocolate** consists of the powder of cacao beans duly prepared and combined with sugar and vanilla. **Chocolate cream** consists of chocolate, 8 ounces; condensed milk, 1 tinful; loaf-sugar, 80 ounces; the white of two eggs and $1\frac{1}{2}$ ounces essence of vanilla made into a paste.[29]

Many coloured sweets are harmless, and owe their colour to innocent materials. Thus, red may be due to the juice of beet-root, currants, cherries, cochineal, or carmine; blue to litmus, saffron-blue, or indigo; yellow to saffron, saff-flowers, marigold, or turmeric; green to a mixture of those which give blue and yellow colours; black to Spanish juice or Chinese ink.[30] But many of the colouring agents used are poisonous, especially those made from copper, arsenic, prussian blue, salts of zinc, or barium; many aniline colours are used, especially those of the "azo" class, some of which are injurious—*e.g.*, it has been proved by experiments on animals that picric acid, dinitro-cresol, and Martin's yellow among these are poisonous; magenta, sulphonated-nitro colours, and most of the azo class, are not poisonous, but may cause vomiting, diarrhœa, and albuminuria.[31] Though there is evidence that most of the coal-tar products are not poisonous to the lower animals used for experiments, it is not safe to assume that they are entirely harmless to human beings. For instance, Weber found that oroline yellow (acid yellow), diluted as much as 1 in 16, will retard the action of pepsin in artificial digestion experiments; and methyl orange, saffoline (acid red), and magenta, which are used for colouring sweets, seriously interfere with pancreatic digestion.[32]

Grape-sugar, also called dextrose and glucose ($C_6H_{12}O_6$), is when pure a fine white powder consisting of six-sided crystals. In its impure state it is distributed throughout the vegetable kingdom, and enters largely into the composition of many fruits, where it is associated with levulose, as previously shown. It can be manufactured by the action of dilute mineral acids upon starch, cellulose, or cane-sugar, and is used in the manufacture of artificially-prepared foods, beer, vinegar, etc.

LÆVULOSE, levuglucose, fructose, or fruit-sugar ($C_6H_{12}O_6$), as an uncrystallizable sugar or syrup, accompanies dextrose in many fruits, and has the same formula. Lævulose, as a white powder prepared from inulin, is soluble in water and sweeter than cane-sugar, and is recommended for diabetics up to $1\frac{1}{2}$ ounces a day. During its use none of it appears in the urine. When a solution of cane-sugar has a little mineral acid added to it, and is then warmed and allowed to stand, it becomes converted into dextrose and lævulose, and when evaporated the mixture is a brownish coloured mass called 'invert-sugar.' This material is manufactured in bulk, and sold for making jam, marmalade, and alcohol.

MOLASSES, treacle, or golden syrup, is produced during the manufacture of cane-sugar, and is largely used as a dietetic article. Girrard gives the following analysis:[33]

(*a*) **Sugar-cane molasses**: Water, 18·5 to 19·5 per cent.; mineral matters, 2·3 to 2·6; cane-sugar, 34·2 to 34·6; glucose, 29·7 to 32·8; organic and colouring matters, 11·6 to 14. The mineral matters are salts of potassium and sodium, with a little magnesia and lime, which have the effect of preventing the crystallization of the sugar. Another analysis showed treacle to contain—water, 16·8 per cent.; cane-sugar, 44·8; glucose, 7·12; lævulose, 5·8; ash, 8·21.[34]

(*b*) **Golden syrup** is frequently a manufactured article, and ought not to be regarded as **treacle**. A comparison of the following analysis with the former[35] will show the difference: Moisture, 22·74 per cent.; cane-sugar, 11·30; maltose, 16·84; dextrose or glucose, 15·56; dextrin, 13·2; gallisin, 14·4; combined maltose, 0·61; ash, 1·34.

(*c*) Girrard's analysis of **beet-root molasses** shows it to contain—water, 18·10 per cent.; mineral matter, 12·74, cane-sugar, 49·0; glucose, traces; organic and colouring matter, 19·86. The small proportion of glucose reduces considerably the total proportion of carbohydrate, and makes it less nutritive than sugar-cane molasses. The excess of salts and organic matter also renders it somewhat unpalatable, and detracts from its value as a dietetic article.

HONEY is a saccharine material collected and stored by bees (*Apis mellifica*, genus Hymenoptera). A wasp of tropical America

and an ant of Mexico, besides other insects, produce syrupy sugars called **honey**, which are scarcely comparable with the honey of commerce. Bee's honey is a viscid, transparent, yellowish-brown liquid, which gradually becomes more or less opaque and partly crystalline. It is of very sweet taste and characteristic odour, exceedingly nutritious, demulcent, and laxative. It contains about 75 per cent. of sugar, in which lævulose and dextrose are mingled in nearly equal parts, with some cane-sugar and mannite. It also contains a small proportion of alcohol, together with wax, pollen of flowers, alkaloidal principles, odorous matters from plants, and a little mineral matter. The lævulose is derived from cane-sugar by inversion or fermentation. Hoitsema[36] gives the following composition of honey: Water, 8·3 to 17·8 per cent.; ash, 0·13 to 0·34; pollen and wax, 0·02 to 0·46; reducing sugars, 71·2 to 74·5; sucrose, 0·2 to 2·6. The **honey-comb** consists of beeswax; but both honey and the comb have been adulterated, by glucose in the honey and paraffin wax moulded to imitate the comb.

Mead is a fermented liquor prepared by dissolving honey in three times its bulk of boiling water, adding a small portion of ground-malt, with some spices for flavouring, and fermenting it with yeast.

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CHAPTER XVI

THE CEREALS AND THEIR SUBSTITUTES

The Cereals are varieties of wheat, rye, barley, oats, rice, and maize, whose value as food is in the order mentioned. This is the most important class of foodstuffs provided by the vegetable kingdom, as they form 'the staff of life' for many millions of people in every quarter of the globe. So large a part do they fulfil in domestic preparations that it is almost safe to say that if the entire crop of cereals failed for one year nearly 90 per cent. of the inhabitants of the earth would die. What have we that adequately takes their place? A few nuts and beans, the fecula derived from various roots and trees, as arrowroot, sago, tapioca, poi; potatoes, yams, artichokes, parsnips, carrots; and the fruit of a few trees, as bananas, bread-fruit, dates, figs, and olives. The cereals are therefore justly esteemed *princeps facile* in all considerations of food.

Wheat is a plant and seed of Triticum, N.O. Graminaceæ, by far the most important kind of grain grown in Europe and all climates of the temperate zones of the earth. There are many varieties, of which *Triticum hybernum*, the winter or unbearded wheat; *T. æstivum*, the summer or bearded wheat; and *T. spelta*, German wheat or spelt, are the permanent and principal varieties. Wheat grows readily in the temperate regions, of which it is for the most part a native, and will grow in almost any region of the earth. The soil best adapted for wheat is a heavy loam or rich clay, and the differences in the grain arise mainly from the soil and mode of cultivation. Winter wheat is sown in the autumn of one year and gathered the next, but summer wheat is sown in the spring of the year in which it is garnered. The names *red* and *white* refer to the colour of the grain. Red wheat is a hardy variety, but the yield is less and the quality poorer than that of white. Spelt is not of the same value as either summer or winter wheat, but it will grow in more elevated regions and on poorer soil. The United Kingdom of Great Britain and Ireland is dependent very largely upon foreign

sources for its wheat-supply, as shown by the *Navy League Journal*, March, 1903, which gives the consumption of this grain in 1901 as 30 million *quarters*, of which only 6·56 millions *quarters* were home-grown, 15·63 were from the United States of America, 2 millions from Canada, 2·43 from Australia, 1·95 from South America, and 1·43 millions from other countries, including 780,374 quarters from India and 602,804 quarters from Russia.*

Composition. — Wheat grain has been analysed by many chemists, who give slightly different reports, inasmuch as all samples vary in quality. König[1] gives the following average of 250 analyses: Water, 13·56 per cent.; nitrogenous matters, 12·42; fat, 1·70; sugar, 1·44; -dextrin and gum, 2·38; starch, 68·07; fibre, 2·66; ash, 1·97. The ashes contain the following in 1,000 parts of wheat—viz., 19·7 parts of ashes, consisting of: Potash, 6·14 per cent.; soda, 0·44; lime, 0·66; magnesium, 2·36; ferric oxide, 0·26; phosphoric acid, 9·26; sulphuric acid, 0·07; silica, 0·42; chlorine, 0·04. Phosphate of potash is in the largest proportion; then follow phosphates of magnesia and lime. Soda is in small amount, but the proportion of iron is good. As a typical food, wheat is deficient in salts and fat, and the proportion of nitrogenous material, though fairly high, is not sufficient to make wheaten bread a perfect food.

The nitrogenous proximate principles form a complex body called **gluten**, which can be obtained from wheat by kneading the flour into a paste with water, then washing out all the starch by a thin stream of water. Gluten is a yellowish-gray, elastic, and very adhesive mass, which holds the meal together when it is made into bread. It consists of the following substances:[2] Gliadin, glutenin, edestin (a globulin), leucosine an albumose, and a proteose. Gluten is a term used to cover all the proteids. Best wheat contains 10 to 14 per cent., inferior only 8 or 9, wheat flour 8 to 12. Kenwood states that flour containing less than 8 per cent. is not pure wheat flour. The flour of hard wheat contains more than that of soft.

These nitrogenous principles also exist for the most part in the

* The imports of wheat in 1904 were nearly 99 million *hundredweights*, as follows: Russia, 23·5 millions; United States, 7 millions; Argentina, 21·4 millions; East Indies, 25·4 millions; Australia, 10·2 millions; New Zealand, 0·358 million; and Canada, 6·19 millions ('Life and Labour,' in *Daily News*).

gluten of rye, oats, and barley; but glutenin, the viscid principle which holds the meal together when it is made into bread, is deficient in the latter cereals, so that they do not hold together so well when made into paste, and it is absent from the legumes altogether.

The starch consists of oval or round grains, varying in size from the merest point visible under the microscope to about $\frac{1}{1000}$ inch in diameter, large and small being often mixed without intermediate sizes. Each grain has a hilum and concentric lines, as in other starch grains, but they are scarcely visible.

Wheat is ground into flour to make bread. Good grain yields 75 to 85 per cent. of fine flour, but inferior qualities only yield 54 to 58 per cent. All the cereal grains have an outer covering or 'husk' of a yellow-brownish colour, and an inner part which is more or less white, yielding the **feculum**. The outer covering is removed when superfine flour is made, and constitutes 'bran.' It contains a large proportion of gluten—15 per cent.; fat, 3·3; and phosphates and silicates, 5·7. Its removal, therefore, diminishes the nutritive quality of the flour. The process of 'bolting' to make the flour white has the effect of removing the coarser parts, and leaving behind the 'fine firsts' of the dealer. By this process the flour is deprived of 18 to 20 per cent. of the gluten in the coarse brownish particles which are taken out, but the lighter and whiter flour is rich in starch. Indeed, the whiter the flour the less nitrogenous material is left in it. *Brown flour*, being unbolted and containing the 'bran,' is far more nutritious, from which it follows that the removal of the bran and so much gluten to render the flour white is wrong from an economical standpoint.

Composition of Flour.—Nitrogenous matter (gluten), 8 to 11 per cent.; carbohydrate (starch, sugar, dextrin), 60 to 70; fat, 2; salts, 1·7; water, 15. Girrard gives[3] the following result of the analysis of French wheat as represented by flour: Water, 14·74 to 15·58 per cent.; *soluble in water*, 3·12 to 4·0 (including glucose, 0·09 to 0·21; saccharose, 0·86 to 1·7; nitrogenous matters, 1·02 to 1·28; galactin, etc., 0·52 to 0·99; inorganic salts, 0·22 to 0·66); *insoluble in water*, 79·94 to 80·94 (including gluten, 7·45 to 8·32; starch, 69·88 to 71·22; fat, 0·84 to 1·12; inorganic salts, 0·20 to 0·40; cellulose, 0·22 to 0·25 per cent.). Girrard

considers the usual statement of the amount soluble in water—viz., 10 to 12 per cent. of flour, about half of which is glucose and dextrin—is erroneous.

Bread is the food made by moistening flour with water, adding yeast to ferment it, kneading it into dough, and baking it. It is usually made from the flour of wheat, but barley, oat, and rye flours are also used, and in times of scarcity the fecula derived from other plants.

The following is the composition of fine wheaten bread, according to König: Water, 38·51 per cent.; nitrogenous material, 6·82; fat, 0·77; sugar, 2·37; carbohydrate, 50. Other authorities give the nitrogenous substance (gluten) as 8 per cent. and carbohydrate (starch, etc.) as 48 per cent.

Bread is made by mixing flour with 50 or 60 per cent. of water and some salt and yeast (preferably from malt and hops); the whole is kneaded into dough by hand or machinery, and left for some time in a room of moderate warmth. The yeast contains the fungus *Torula cerevisiæ vel saccharomyces*, which grows throughout the dough, and during its metabolism converts some of the starch into sugar, which in turn is decomposed into alcohol and carbonic acid. All the sugar is not decomposed, for bread invariably contains more sugar than the flour from which it is made. The alcohol evaporates, its escape being aided by the warmth of the material; the generation of carbonic acid gas renders the dough vesicular or causes the holes which are seen in light, spongy bread, the dough swelling more and more as the gas is developed throughout the mass. When light enough it is formed into loaves and baked in an oven, during which the soluble albumin becomes insoluble, and the other constituents of gluten are 'set,' so that they cannot be separated from the starch. The fat and salts are not altered. A sack containing 280 pounds of flour will make 100 to 115 quartern loaves, according to the amount of water in the dough and whether cooked as cottage or tin loaves.

When the dough is neglected, and fermentation is allowed to pass a certain limit, acetic acid is formed, and the bread becomes sour. During cooking the loaves swell up still more, owing to the formation of steam from some of the water; but as the water in the exterior is the first evaporated, this portion becomes crisp and firm, and forms a crust upon the surface. A well-baked loaf

should have a bottom crust which is hard and resonant, while the crumb is elastic and spongy. If the crumb can be rolled into a ball, and remains so, either the bread is not sufficiently baked or the flour is deficient in quality. Good bread crumbles and is spongy, and expands again when it is compressed with the fingers. Freshly-ground flour is too adhesive to make good bread. It is usual to keep it a few weeks, care being taken to preserve it from damp, sometimes turning it over, until it readily falls apart in the hand.

Aerated bread is made without the aid of yeast, by which means fermentation is avoided and some of the starch saved. It is usually made by machinery; it is therefore more cleanly prepared, the hands of the baker not being used to mix or mould it, and contaminations of various character are avoided. Flour is put into the machine, the atmospheric air is abstracted and replaced by carbonic acid gas, and the dough is made with aerated water. The machine kneads the dough, turns it out to be caught in tins, which are placed upon an endless floor moving slowly over the fire, and the loaves, done to a turn, light and spongy, emerge from the opposite extremity. Bread so made is highly commended, because contamination is avoided. There is no danger of sourness from over-fermentation, and consequently less frequent indigestion, heartburn, and flatulence among the consumers. On the other hand, some authorities urge that bread made with yeast is more easily digested, being more easily changed by the digestive juices, than aerated bread.

Aerated bread can be made on a small scale by using 'baking powder' containing carbonate of soda and tartaric or citric acid, or by mixing some bicarbonate of soda with the flour and hydrochloric acid with the water used to make the dough. By the action of the acid on soda, common salt and carbonic acid are formed, whereby the bread is aerated. The cooking is to be done immediately, and the result is a very sweet and delicious bread, rather yellow from the presence of soda if that is used in excess. The following recipe is useful: Take 6 pounds of white flour, 6 drachms of hydrochloric acid, 6 drachms of bicarbonate of soda, and 3 pints of water. Rub the soda well into the flour to mix it thoroughly; add the acid to the water, and mix by agitation; make the dough by stirring them together, and bake at once.

Wheaten bread is the finest, most wholesome and palatable of all; but its flavour and nutritiveness depend on the quality of the wheat. Soft wheat makes the whitest flour, but hard wheat is richer in gluten and more nutritive, and there are many grades between. The desire for *white* bread has been the means of introducing improved machinery for milling the wheat and various adulterations. The addition of **potato**, a harmless fraud which probably arose in periods of scarcity when attempts were made to eke out the wheat-supply in many ways, makes the bread whiter, but, of course, reduces the nitrogenous material in proportion to the adulteration. **Alum** is also used to make the bread white, but it lessens the nutritive value by converting the phosphates into the *insoluble* aluminium phosphate. Alum normally exists in bread to the extent of about 6 or 8 grains in a quartern loaf; any excess can only be due to addition, and it is a prolific source of dyspepsia and constipation. Excess of alum in bread may be detected by the use of logwood. Make an infusion of logwood with distilled water, and pour it over a slice of bread; if alum is in excess the colour changes to a bluish or violet-gray. **Lime-water** has the same effect as alum in producing whiteness, and the bread so made is equally soft and retains moisture well; the lime counteracts any acidity in the bread, and supplies a deficiency in all grain; its action, therefore, is on the whole beneficent rather than deleterious.

Other adulterants consist of the meal of barley, rye, oats, rice, maize, beans, lentils, and vetches. Rye-bread comes next in value to wheaten; but barley, oats, and maize do not make good bread, as they are deficient in the adhesive properties of wheat; they do not rise during fermentation, and consequently the bread is heavy, close in texture, and difficult to digest. Bean, haricot, or pea flours can be used to the extent of 5 per cent. with wheat flour for making bread without imparting an unusual odour, taste, or appearance, excepting that bean flour gives to the crust a golden-brown colour of agreeable appearance. Lentils and vetches can only be ground up with wheat of an inferior quality, because of their brown colour, but they increase the nutritiveness of bread as much as they darken it. Maize and wheaten flour in equal proportions make a nice bread, but it is not very easy of digestion. Potato has been added for economical reasons

in the proportion of one-third of potato to two-thirds of wheaten flour, made into dough and fermented in the usual way.

Bread is an essential article of food for the denizens of the temperate regions of the earth. It contains all the proximate elements necessary to sustain life for any length of time, and has been styled 'the staff of life'; but the gluten, starch, and sugar, are not exactly combined in the proportions which would make it a typical food. The nitrogenous elements are deficient, for to obtain the necessary amount of nitrogen required to make good the losses of the body by wear and tear of his machinery during an ordinary day's work a man must consume $4\frac{1}{2}$ pounds of bread; unfortunately, that quantity would supply so much more carbohydrate than he requires that much unnecessary work would be caused for his system to eliminate the surplus amount, or otherwise to store up the surplus carbon in his body, and the result would be an individual fat and bulky, having little stamina and less reserve power to endure great mental strain or physical fatigue, or to combat a serious illness. A typical and simple daily diet would consist of $1\frac{3}{4}$ pounds of bread, with $\frac{1}{2}$ pound of lean meat and 2 ounces of butter to supply the deficiency of fat and nitrogenous material in the bread. Such a diet is the simplest combination, requires the least expenditure of energy in the way of digestion and absorption, and involves the least amount of waste in the animal economy. Excess of bread, on the other hand, causes acidity, flatulence, and other signs of indigestion, and when habitually taken leads to excessive formation of fat in the tissues and corpulency.

New bread and hot rolls, however delicious they may be, are indigestible, and should be eschewed by all who desire to keep their stomach in a proper working condition. What is the condition of new bread? When it is taken out of the oven it is moist, the gluten and starch are soft and adhesive, the bread is not set; consequently, it is not porous and does not absorb moisture. When new bread is masticated it becomes a leathery, poreless, putty-like mass, into which the saliva cannot enter, and the portions which are swallowed lie upon the stomach like bullets, whose digestion is certainly prolonged, if not prevented. Bread should always be kept for twenty-four hours in a cool place before it is eaten; it ought to keep soft and palatable for three or four

days, and home-made bread will keep moist for a week. Toasted bread and cakes are indigestible, because the flour becomes soaked with the butter, and the latter must be removed by saponification in the intestines before the digestive ferments can attack the starch ; the digestion of buttered toast, muffins, pancakes, cakes, and other articles rich in fat, is necessarily slow and often very much delayed.

Brown or Whole-meal Bread.—The covering of wheat and other cereals contains much phosphate of lime and silica, which render the cellulose abnormally hard of digestion ; it is removed from superfine white flour in the form of 'bran,' which contains 15 per cent. of gluten, 3·3 of fats, and 5·7 of salts. It is therefore necessary to admit the high percentage of nutriment in bran, and the consequent diminution of it in wheat from which it is removed. **Brown bread** is made from whole meal—that is, from wheat which is not deprived of bran, or which has not been 'bolted'; consequently, it contains the full complement of the nutriment in the unground wheat, and certainly contains a greater proportion of gluten and phosphates than white bread. Majendie proved the difference in the value of brown and white bread by feeding two dogs : one was fed with white bread, and died after forty days ; but the other, fed on brown bread for the same length of time, lived without any interference to its health. Brown or whole-meal bread is now largely in favour, and many special kinds are made ; it is more nutritious, contains more gluten, and is sweeter than white, and promotes the action of the bowels in a moderate degree ; but that which contains coarse bran is irritating to the stomach and bowels, and may cause catarrh and diarrhœa : it should therefore be eschewed by persons who have a weak stomach or delicate bowels. Whole-meal bread, in which the bran is reduced to a fine powder by modern methods of grinding, is deserving of an extended trial, because its nutritive qualities are great and the irritating properties are reduced to a minimum.

Pastry and cakes consist of the flour of wheat mixed with water or milk, butter or lard, and various ingredients which give flavour, palatability, and an agreeable appearance to the whole. Cakes are the means of adding largely to our nutriment by the sugar, eggs, butter, and flour they contain. Pastry and cake are,

however, not very easily or quickly digested, because the butter or lard is so intimately mixed with the flour that the digestive juices cannot get at the latter until the fat is melted and separated from it; for this reason very little pastry or cake is digested in the stomach: it must pass into the intestines for the previous digestion of the fat before the floury portion can be acted upon. This is the reason why cakes and pastry are such a frequent cause of acidity, heartburn, indigestion, and other disagreeable sensations in the region of the stomach and heart; an excess of them readily causes an attack of acute gastric catarrh in persons liable to it. Heavy or close pastry is even worse than the average make of this useful accompaniment of the repast, because unusual care must then be taken in mastication to insure the perfect pulverization of the mass before it is swallowed. Human stomachs are not gizzards which can grind their food after it is eaten. If great care be not taken in the mastication, it is impossible for the unbroken particles to pass through the pylorus until, by long maceration, the hard particles have fallen apart. The latter objection has also to be raised against boiled pastry puddings, Yorkshire pudding, pancakes, muffins, and new bread; however delicious and rich in nourishment these may be, they will tax the ability of the best digestive organs to extract the nourishment from them if they are close and heavy instead of being light and spongy.

Puddings are made of many things: the flour of wheat, bread, macaroni, vermicelli, semolina, barley, oatmeal, maize, rice, sago, tapioca, etc. Milk enters largely into their composition, and the nutritiveness is materially increased by eggs and butter. Milk puddings, in the usual acceptation of that term, are light and easy of digestion, suited equally to the stomach of the healthy, the invalid, aged, or children; they are far better adapted for persons of sedentary occupation or having mental work to perform than the heavy puddings made with a boiled pastry crust; but the latter are suitable for the youthful and vigorous, and especially for those leading an active life, with some part of their time in the open air.

Most of the farinaceous materials used in puddings contain much starch, as wheat flour, 60 to 70 per cent.; oatmeal, 51 to 55; rice, 75 to 80; maize, 59; barley, 70; but the admixture of

the albumin and fat of milk, eggs, and butter, together with some sugar, makes them very nearly a typical representative food.

Macaroni, vermicelli, and semolina, imported from Italy, consist of the flour of wheat. In the two former it is made with a small quantity of water into a paste of the proper consistency, which is then driven through a perforated vessel to give it shape; after being partly baked, it is hung over rods to dry. Semolina is decorticated wheat, crushed, sifted, and in small pearl-like grains. They are all of the same intrinsic value as wheat, are used in milk puddings, and are soft, light, wholesome, and easily digested. Vermicelli is the best of them for thickening soup, but semolina is also used for the same purpose.

Rye, the seed of *Secale cereale*, N.O. Graminaceæ, has been cultivated from ancient times, and considered next to wheat as a grain-food provider. It was formerly grown extensively in Britain for making bread, but its main use in England at the present time is to provide green fodder in the spring for cattle. As an esculent grain, however, it is by no means despicable, and it is extensively grown for bread-making on the Continent of Europe, in districts where it is a less uncertain crop than wheat, and requires less manure and cultivation.

The analysis of rye shows it to contain—water, 14·24 per cent.; nitrogenous matters, 10·97; fat, 1·95; sugar, 3·88; gum, 7·13; starch, 58·73; fibre, 1·63; ash, 1·48. According to Osborne,[4] the nitrogenous materials consist of—gliadin, 4·0 per cent.; leucosine an albumose, 0·43; proteose, 1·76; and 2·45 per cent. of proteids insoluble in salt solution; total, 8·63 per cent. obtained from rye devoid of the bran.

The salts are composed chiefly of phosphates of potash, soda, lime, and magnesia, and 2·54 per cent. of oxide of iron. The starch grains are like those of wheat, but many have a peculiar rayed hilum.

Rye is made into bread, can be 'malted' to make beer, and is also used in the distillation of gin.

Rye bread is dark coloured, hence called 'black bread.'* It is laxative and acid, prone to cause diarrhœa in persons unaccustomed to it. The ill-effects produced in some persons by the long-continued use of rye bread are painful cramps and twitch-

* Black bread is also made from buck-wheat, which is called *blé noir*.

ings in the limbs, sometimes followed by dry gangrene. These effects are due to ergot of rye, the fungus *Claviceps purpurea*, which attacks the grain and causes it to swell up and turn black. The seed is, in fact, replaced by a homogeneous tissue charged with an oily fluid, which develops the herring-like odour of **propylamine** when liquor potassæ is added to ergotized flour. The active principles in ergot of rye are four, but it would serve no useful purpose to dwell upon them here.

According to König, the composition of rye bread is as follows: Water, 44·02 per cent.; nitrogenous matters, 6·02; fat, 0·48; sugar, 2·54; starch, 45·33; fibre, 0·3; ash, 1·31. It is nutritious, but heavier and more difficult of digestion than wheaten bread. The dark colour, acidity, and general tendency to upset the digestive organs in those unaccustomed to it contrast greatly with the fine qualities of white bread used at ordinary times by highly-civilized people. It should not be eaten until at least two days old, and is said to be lighter when leavened with a mixture of wheaten flour and potato instead of brewer's yeast. In any case it requires baking slowly and for a long time to secure panification. In times of scarcity rye is often mixed with wheaten flour to make bread, in the proportion of one of rye to two of wheat, and equal parts of rye, wheat, and barley or rice, are said to make good bread.

Barley, the varieties of Hordeum, N.O. Graminaceæ. Those commonly cultivated are *Hordeum distichum*, which bears two rows of flowers and seeds; *H. vulgare*, having four rows; and *H. hexastichum*, six rows. Barley bread was formerly a common food in England among the serfs, but has been little used for centuries, barley being now mainly grown for the manufacture of malt liquors and spirits, and for feeding cattle and poultry.

The composition given by Wynter Blyth is as follows: Water, 15·06 per cent.; nitrogenous material, 11·75; fat, 1·71; carbohydrate, 70·9; fibre, 0·11; ash, 0·47. The salts are phosphates of potash, soda, lime, and magnesia, iron 0·97, and silica. The starch is in grains almost indistinguishable from those of wheat, but said to approach to cellulose in character, and is therefore more difficult of digestion. The nitrogenous materials are similar to those of wheat—viz., **hordein**, resembling gliadin, 4 per cent.; globulin (edestin) and proteose, 1·95; leucosine, 0·3; insoluble proteid, 4·5; total, 10·75—but they are not sufficiently adhesive

to make good bread. Barley flour can be mixed with those of wheat and rye, as already indicated. It contains a large proportion of starch, but the mixture of bean or pea flour with it would increase the nutritive value. Barley bread has a sweetish taste, but is less palatable and nutritious than wheaten. An analysis from the same source is as follows: Water, 12·39 per cent.; nitrogenous material, 5·9; fat, 0·9; sugar, 3·9; carbohydrate, 71; fibre, 5·63.

Pearl barley, *H. decorticatum*, is the grain deprived of its husk and outer covering or bran, rounded and polished. It is used in puddings, soup, and barley-water.

Barley-water, or decoction of barley, is made by boiling 2 ounces of pearl barley and 2 ounces of sugar for one hour in 3 pints of water. It may be flavoured with a sliced lemon. It contains little nutriment, but is useful as a drink in febrile attacks. It is demulcent, emollient, expectorant, diuretic, and sedative to the urinary organs and all mucous surfaces. In cystic catarrh or irritability it is very serviceable, especially to the aged or debilitated, who have frequently to rise in the night to urinate.

Malt, of which more will be said in the chapter on stimulants, is made by causing the barley to germinate under the influence of moisture and artificial heat until the germ has attained a length equal to about two-thirds that of the grain; it is then dried. Valentine found that pale malt contains—starch, 44·15 per cent.; sugar, 21·23; albuminoids, 13·9; fat, 1·65; cellular matter, 11·57; and ash, 2·6. It differs from barley in containing more sugar (which is derived by modification of the starch), more dextrin, less organic matter, and an active ferment, **diastase.** Diastase can be extracted from malt by grinding the latter to powder, macerating it with twice its bulk of water for five or six hours, then expressing and filtering the liquid. Twice its bulk of absolute alcohol is now mixed with the liquid, and very soon the diastase is precipitated, and can be collected, spread on glass, and dried at a temperature of about 45° C. in a current of air.

Malt is largely used for the manufacture of **extract of malt,** a very excellent dietetic preparation of medicinal value. Such an extract is made by maceration of the powdered malt with water at an ordinary temperature with occasional mixing for five or six hours. The liquid is then expressed, strained, and evaporated in a temperature of about 115° F. (45° C.)—not exceeding 125° F.,

otherwise the diastase will be destroyed. Diastase is an active ferment capable of converting the starch of all farinas into maltose, a form of sugar. A good specimen of extract of malt will convert several times its weight of starch into sugar (maltose), ready for absorption into the blood. The extract contains[6] all the principles of barley or malt—viz.: Albumin, 6·39 per cent.; maltose, 45; dextrin, 7·2; invert-sugar, 14·49; cane-sugar, 3·40; and salts, besides diastase. It may therefore be taken with advantage by many persons with feeble power of digesting the starches, or as an actual food in many wasting diseases. It may be taken in a dose of one to four teaspoonfuls with a little warm food immediately before a meal; or if taken about two hours after a meal, when the acid of the gastric juice is becoming exhausted, it will materially assist in the final stages of starch digestion. A further use for extract of malt is in the feeding of infants. The casein of cow's milk normally forms large curds in the early part of gastric digestion, and this tendency is much increased in many cases of illness. If to ½ pint of milk freshly boiled is added a teaspoonful of malt extract, and it is stirred thoroughly and allowed to stand for ten minutes, the ferment of the malt will break up the casein into fine flocculi, like that in human milk, which are easily digested. This must be diluted with water. The fat can be increased by the addition of cream, which together with the maltose will bring it up to about the standard of human milk. A little lime-water can be added.

Oats, the seeds of *Avena sativa* and its varieties, N.O. Graminaceæ, is a very large and nutritious article of diet, either as porridge, pudding, or oat-cake. The composition of oats according to the analysis of 1,000 samples by Balland[7] and of oatmeal by Dyer[8] is here given:

	Water.	Fat.	Nitrogenous Matters.	Carbohydrate.	Cellulose.	Ash.
Oats	9·8 to 17	2·8 to 6·83	7·1 to 14·3	56·9 to 64·3	7·0 to 12·2	1·5 to 6·9
Oatmeal, fine ...	8·2 to 9·5	8·0 to 12·23	12·9 to 18·1	54·0 to 65·6	—	1·7 to 4·0
,, coarse	7·9 to 9·1	8·7 to 10·32	13·0 to 15·4	64·5 to 65·2	—	1·7 to 1·9
Crushed oats ...	8·1 to 8·9	7·5 to 9·3	12·6 to 15·1	65·2 to 67·0	—	1·6 to 1·9

They contain a larger proportion of fat than wheat or barley, and the proteids are high. Scotch oats are richer than English or German. The starch grains are small, compressed, faceted, and tend to cohere in masses. The value of oatmeal as an energy-provider may be seen by a comparison of the energy represented in *foot-tons* of work developed, according to Parkes,[9] by the complete oxidation of an ounce of the following foods: Potato, 33 foot-tons per ounce; egg, 68; bread, 88; cooked meat, 106; pea flour, 119; *oatmeal*, 130; cheese, 150; butter, 339.

Oatmeal is one of the most valuable foods we possess. It ranks very high both as a flesh-former and energy-provider, and is at the same time one of the most economical materials provided by Nature. Being rich in heating and fattening principles, it forms with milk an ideal food in the form of porridge or pudding. It is somewhat laxative, hence its value to persons who suffer from constipation. Its stimulating properties render it a highly useful diet for persons doing mental work. Oatmeal requires to be carefully prepared, for if it contains hairs, husks, and other material of the outer covering, it will irritate the mucous membrane of the stomach and bowels, and is liable to cause catarrh of the stomach or diarrhœa, or form hard fæcal accumulations or concretions in the bowels.

Bread made from oatmeal by the aid of fermentation is soft in texture and wholesome. The cakes are unfermented, made flat, and either baked or roasted. The stomach requires some discipline before it can digest either of them with ease and comfort.

Oatmeal, like other cereals, has valuable *salts*, of which Blyth gives the following analysis: **Potash**, 17·0 in 100 parts of salts; soda, 2·24; lime, 2·74; magnesia, 7·06; ferric oxide, 0·67; **phosphoric acid**, 23·03; sulphuric acid, 1·36; silica, 44·73; chlorine, 0·58. Of all grain this is the richest in phosphates, which give it additional value as a food in cases where phosphates are valuable, as in hectic, struma, scrofula, caries of bone, all diseases of tubercular origin and wasting diseases generally.

Sorghum, Millet, Durra, belong to a genus of the Graminaceæ, with various species. Millet is the common name for small varieties, as *Panicum miliaceum* and *P. miliare*. *Sorghum vulgare* is

the largest of the cereal grains, and is called Indian millet or Guinea corn. Sorghum, *sorghi*, is the Indian name for millet; durra, that most used in Egypt and Arabia. These grasses have tall, succulent stems, and are cultivated mainly for feeding cattle and poultry in Southern Europe. But they form an important food for man, of about the same value as rice. They are used freely by many of the inhabitants of East India, China, Arabia, Syria, Egypt, and other countries. Millet is rich in fat and nitrogen, makes good bread, and is physiologically a more complete food than wheat. Balland[10] gives the following composition: Water, 10 to 13 per cent.; nitrogenous matters, 8·9 to 15; fat, 2·2 to 7·3; sugar and starch, 56 to 66; cellulose, 3 to 10; and ash, 1·4 to 6.

MAIZE, INDIAN CORN, *Zea maïdis*, N.O. Graminaceæ. A native of America, and cultivated in warm countries. Corn meal, or ground maize, is rather coarse, and is used in porridge or mush and puddings. Being rich in fat, it possesses fattening, heating, and stimulating properties. It has been used as the basis of many patent foods. Corn and wheat flour in equal proportions make a nice bread, which keeps well, but is not easily digested. The green corn or 'mealie' boiled in milk or roasted in ashes is an excellent and nutritious vegetable.

Composition.—Osborne[11] derived from 100 grammes of maize or corn meal 8·59 grammes of proteid, including 5 soluble in alcohol, which he called **zein**; 3·14 of insoluble proteid; 0·39 of globulins — maize-myosin, maize-globulin, and maize-vitellin which appears identical with edestin of the other cereals. The ash contains phosphate of potash and magnesia, some soda, lime, and magnesia, and 1·23 per cent. of ferric oxide.

	Nitrogenous Matters.	Fat.	Carbohydrate.	Sugar.	Fibre.	Ash.	Water.	Analyst.
Yellow maize	10·11	4·23	67·44	2·70	1·43	1·40	12·6	Z. & M.[12]
White maize	9·56	4·84	61·36	2·68	1·72	1·72	13·3	„
Corn meal...	14·0	3·88	70·68	—	—	0·86	10·63	Bauer.[13]

The starch consists of fairly uniform granules, which are faceted or polygonal, about $\frac{1}{1000}$ inch in diameter; the hilum is distinct, but the concentric lines are faint.

Polenta, largely consumed by the poor of Italy, is a kind of pudding made from maize meal; and **pone** is a name applied to bread or cake made from corn meal, eggs, and milk; *hominy* or corn-mush and hoe-cake are names applied to similar preparations in the United States; and corn flour or corn starch is chiefly the starch obtained from maize. If long kept corn meal will go rancid, owing to degeneration of the fat or maize oil; and pellagra is a disease which results from eating mouldy maize or corn meal, which has especially been prevalent in Lombardy. Maize when growing is liable to be attacked by a fungus, *Ustilago maydis*, when it is used therapeutically in the same diseases as ergot of rye.

RICE, *Oryza sativa*, and varieties, N.O. Graminaceæ, is grown in the East Indies and adjacent countries, in the marshy districts of Southern Europe, and in some of the Southern States of America.

Composition.—Rice contains, according to Parkes—starch, 83·7 per cent.; fat, 0·8; nitrogenous matters, 5; salts, 0·5; water, 10. Other authorities have found as much as 7 per cent. of nitrogenous and as little as 77 per cent. of starch. The salts are phosphate of potash and magnesia, some lime, soda, silica, and 1·23 of ferric oxide. The starch grains are extremely minute, nearly uniform in size, polygonal or angular, like those of maize, without visible hilum or lines.

Rice is poor in every alimentary principle except starch; it, however, forms a light, wholesome, and unstimulating food. It is largely used as a food by the teeming millions of the East, and is suited to their temperament and the climate. But for the populations of temperate, and especially northern, climates it is not sufficiently stimulating to form a principal food, and should be taken in combination with other articles, forming a single course of the repast rather than the whole of it. It is a cheap addition to our food-supply, and is best eaten as a pudding, in which the nutriment is decidedly increased by the admixture of milk, eggs, and sugar. In such a form it is a typical diet—'rice pudding'—of enormous value in nearly all forms of illness and invalidism. **Curries** consist mainly of boiled rice and various spices, such as cayenne pepper, and are very heating and stimulating by virtue of the added ingredients. Rice flour is also made into cake with butter and eggs, and is very nutritious, but, like other cakes, may

cause indigestion. Rice flour does not make bread by itself, but in times of scarcity it may lessen the consumption of wheat by being mixed with the latter to make bread as well as by being eaten in other ways.

Rice is imported and known to commerce under various names. Of these **Patna** rice is the best for curry, or for boiling or making into flour. The grains are long and narrow-pointed, very firm, and do not become mealy in cooking. **Carolina** rice consists of larger and rounder grains, which swell up and become soft and pulpy during cooking. It is most suitable for milk puddings, those made of it being creamy and very palatable. **Japan** rice has similar characters and qualities to the Carolina, and is almost as highly esteemed for puddings. **Java** rice is also good, and of better quality than that of Arracan or Rangoon.

SAGO is the starch obtained from the pith of the Sago palm, *Metroxylon rumphii et læve*, N.O. Palmaceæ, which grows in the Moluccas. It exists in commerce as raw and prepared sago. The starch is obtained by felling the tree and sawing it to pieces; the pith is taken out, broken up, put into cold water, and stirred about until all the flour comes off and falls to the bottom, where it is allowed to settle and accumulate. The water and coarse material are then separated, the deposit is taken out and spread upon wicker frames for the moisture to evaporate from it, and it is then passed through a perforated apparatus to give it a granular appearance. It is of a brownish colour. Examined microscopically, the starch grains appear large and irregular, with ill-defined concentric striæ. Sago is used mainly for puddings, which are made with milk, eggs, and sugar, possesses similar alimentary properties to rice, and is equally suitable for food.

TAPIOCA is the starch obtained from the pith and root of Cassava, *Manihot utilissima*, N.O. Euphorbiaceæ, a native of Brazil. It is obtained in a similar manner to sago, and is dried in the sun or upon hot plates, and the mass is broken into granules, or the paste driven through an apparatus to give it the rounded shape usually seen. Tapioca is whiter than sago, and is preferred by many people. The best commercial varieties are those of Penang and Rio. Tapioca consists mainly of starch grains having irregular and ill-defined markings, and when dried upon hot plates they become more or less swollen and indistinct.

It is one of the lightest of farinaceous foods, seldom causing acidity, and easily digested in the form of pudding, soup, or broth, by the robust or convalescent. Cassava root in its season is boiled in several waters and fried, when it resembles potatoes, and is eaten in the same way.

Arrowroot is the starch obtained from the root cassava or *Manihot utilissima*, the same as tapioca, and from *Canna edulis*, and other roots grown in the East and West Indies, South America, South Africa, and various islands of the tropics. The following are the principal varieties known to commerce:[14]

1. Cassava starch or arrowroot, from *Manihot utilissima*, N.O. Euphorbiaceæ, a native of Brazil.

2. Canna arrowroot, *Tous les mois*, from *Canna edulis*, N.O. Marantaceæ.

3. Maranta arrowroot, from *Maranta arundinaceæ*, N.O. Marantaceæ, from Jamaica, St. Vincent, Bermuda, Natal.

4. Potato arrowroot or starch, from ordinary potatoes, *Solanum tuberosum*, N.O. Solanaceæ, a common adulterant of the other kinds, recognisable by the microscope.

The plants are cultivated in a similar manner to potatoes, and come to maturity in a year. The roots are then collected, washed, peeled, and washed again. They are then crushed to a pulp between the rollers of a machine. The pulp falls into a perforated vessel through which water is constantly running. In this manner the starch is washed out and makes a milky liquid. This is strained through muslin into a settling tank. When the water becomes clear it is run off, and the deposit or moist starch is taken out and dried either upon wooden trays having cloth bottoms and covered by gauze, or in copper pans covered with gauze to prevent contamination.

Cassava arrowroot consists of starch grains varying from 0·008 to 0·022 millimetre in diameter. They are for the most part mullet-shaped, some being circular, perhaps, from a different view of the granule, and there are many double or triple grains. **Canna** arrowroot consists of grains of starch which are oval or pyriform in shape, of large size, with well-marked concentric striæ, but the hilum is indicated by a slight cleft or cross at the end of the granule.

The composition of sweet cassava, *Jatropha manihot*, is as follows:[15]

	Fat.	Proteid.	Starch and Sugar.	Fibre and Ash.
Fresh peeled root ...	0·17	0·64	30·89	1·39
Dry peeled root ...	0·44	1·66	80·06	3·57

The carbohydrate is mostly starch, but includes about 2 per cent. of dextrin and sugar. The ash is chiefly phosphate and carbonate of potash. The pulp, crude starch, and ethereal extract, yield a volatile oil. Prussic acid occurs in all the tubers: in bitter cassava 0·023 per cent. is uniformly distributed; in sweet cassava the inner part only contains 0·006 per cent., but the skin and cortical portion, *which are removed*, contain 0·028 per cent.[16]

Manioc or **cassava** consists of the roots ground to a meal, which is pressed into cakes, baked on iron plates, then cooled, broken into pieces, and dried in the sun. Good examples of arrowroot consist of—starch, 83·3 per cent.; albumin, 0·8; salts, 0·27; and water, 15·4. It is a valuable farinaceous food for infants and invalids *under specific conditions*, and is usually mixed with milk and sugar to make it palatable and provide nitrogenous material. It is useful in nearly all cases of diarrhœa, but in ordinary states of health, like other very starchy foods, it is liable to cause constipation.

Poi is the feculum of the root of Taro (*Caladium esculentum*, N.O. Araceæ), a vegetable with a tuberous root grown in Hawaii and other islands of the Southern Pacific. In appearance this is something between a sweet potato and a yam. The flour from it is prepared in a similar manner to arrowroot, or by simply washing and grinding the roots to powder, or by cooking the root and mashing it up. Poi is a paste made from the flour by adding it slowly to hot water and stirring until the mixture has the consistency of paste, and is eaten with salt or sugar. It may also be cooked like corn or oat meal, or made into custard or cakes. Poi is from lavender to pink in colour, is a most wholesome and nutritious article of diet, easy of digestion, suitable for persons with gastric troubles, dyspepsia, acidity, catarrh, ulcer or carcinoma, also in enteric and other fevers, convalescence from many illnesses, and for feeding children.

The natives make poi by beating the roots into a paste and fermenting it for three or four days before use.

Soya Beans, *Soya hispida*, N.O. Leguminosæ; used in China and Japan to make sauce, or ground up and made into a kind of cheese. It is noted for its richness in proteid and comparative absence of starch, which give it an enormous value to patients suffering from diabetes. The flour can be made into bread and biscuits. The bean contains, according to Attfield—41 per cent. proteid, 13 of fat, and 30 carbohydrate. The starch is only about 6 per cent. Most of the carbohydrate consists of a mucilaginous substance which is neither starch nor sugar, but is convertible into the latter, and must therefore be taken into account when soya bread is recommended for diabetes. The bread has a peculiar taste, and may cause diarrhœa at first, but tolerance is soon established.

Buckwheat is not a cereal, but *Fagopyrum esculentum*, N.O. Polygonaceæ, and is known in France as *blé noir*. Cakes and bread made from it are fairly palatable and nutritious. The composition, according to Balland,[17] is—water, 13 to 15·2 per cent.; nitrogenous, 9·4 to 11·4; fat, 1·9 to 2·8; carbohydrate, 58·9 to 63·35: cellulose, 8·6 to 10·5; ash, 1·5 to 2·46. It is not so nourishing as wheat. It grows on the poorest soil, and is consumed in France, Holland, the United States, and parts of Asia.

The chick-pea, or **pulse**, grows wild on the shores of the Mediterranean and in Eastern countries, where it is roasted and forms **parched pulse**. It is also used in cooking in Spain and France.

Yams, *Dioscorea tuberosa;* several varieties are grown in America, East and West Indies, Africa, Malacca, and nearly all tropical countries. The important part is the tuber, which varies in weight from 1 to 30 pounds, and being boiled or roasted forms a palatable, wholesome, and nutritious food. They are eaten like potatoes, and consumed largely in tropical and sub-tropical countries. They contain much starch, become mealy during cooking, and they are not sweet like *Batatas edulis*. The **water-yam**, which grows in running streams in Madagascar, is quite a different thing. It, however, has a stock-root, which contains farinaceous material, and is used for food.

Sweet Potato is the tuber of *Batatas edulis*, N.O. Convolvulaceæ. It is grown in Spain, the West Indies, America, and nearly all tropical countries. The roots are fleshy and spindle-shaped

of sweetish taste, but nutritious, and considered a delicacy by many. They contain 10 per cent. of sugar and 16 per cent. of starch. They become mealy when cooked, and are eaten like ordinary potatoes; but, owing to their sweetness, they are not such an appropriate accompaniment to meat as yams or potatoes.

Irish or Carrageen Moss (*Chondrus crispus*) grows on the rocks and stones of the sea-shore in Britain and many other places. It yields a mucilaginous carbohydrate, and is used for making soup and jelly.

Iceland Moss (*Cetraria Islandica*) is also used as a food in northern climates.[16] The composition, according to C. W. Brown,[18] is—nitrogenous, 0·56 per cent.; fat, 3·2; carbohydrate, 43·3; fibre, 5·3. The amount of proteid is very small, and resists artificial digestion; but it contains a large amount of carbohydrate in the form of lichenin and lichenin starch. The latter gelatinizes like ordinary starch, and is converted by acids into dextrin and dextrose. There is also a bitter principle, which must be removed by repeated washing with water or weak alkalies. It makes a very palatable bread, which Senator recommends for persons suffering from diabetes. When boiled in milk both these mosses will form a jelly, and a decoction is recommended for kidney affections.

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CHAPTER XVII

STIMULANTS AND NARCOTICS

Tea.—The dried leaves of several varieties of *Thea chinensis*, N.O. Ternstrœmiaceæ; grown extensively in hilly tracts of land in China, Japan, Tonquin, Cochin-China, Ceylon, India, and Assam. Great skill and attention are required in its cultivation and preparation. Tea is found growing wild in Assam, which is

said to be the progenitor of all the cultivated varieties. Assam tea is a variety cultivated exclusively in that country. Tea is black or green, according to the method adopted in preparing it. **Green tea** is prepared from young leaves, which are dried by roasting them over a wood fire as soon as they are gathered. In the preparation of **black tea** the leaves are plucked and thrown into a heap or in vessels for about twelve hours, during which a species of fermentation takes place owing to the action of various enzymes. The leaves are afterwards submitted to various processes, and slowly dried over charcoal fires. **Oxydase** enzyme is the principal agent in the fermentation and colouring of tea;[1] it occurs in greatest quantity in the unopened tip-leaf of the shoot and stalk, but it diminishes with their growth and expansion. The proportion of enzyme present in a given sample bears some relation to the amount of phosphates in the soil, and it increases as the leaf withers during the preparation of the tea; the leaves containing the most enzyme make the most highly flavoured tea. The consumption of this more or less innocent stimulant increases with the world's population, and exceeds 150,000,000 pounds a year. China teas are Congou, Souchong, and Bohea, which are black; Hyson, Twankay, and Gunpowder, which are green. Indian tea, Assam, or Assam-Pekoe, are good; and a good blend is made of China, Assam, and Ceylon teas together. China tea, such as Moning-Congou, is very suitable for persons whose digestive organs are weak.

Composition.—Average tea contains—water, 11·49 per cent.; nitrogenous matters, 21·22; gum and dextrin, 7·13; theine, 1·35; ethereal oil, 0·67; fat, wax, and chlorophyll, 16·75; woody fibre, 20·30; ash, 5·11 (König). The active principle is theine ($C_8H_{10}N_4O_2$), which is isomeric with caffeine, and is found in tea, coffee, maté, guarana, and kola-nut; it varies in quantity from 1 to 4 per cent., and it crystallizes from a watery solution, has a slightly bitter taste, but is without odour. The proportion in a sample of tea can be estimated (*a*) by exhausting 100 grammes of tea with water, precipitating it with acetate of lead, and filtering; the theine is further purified by freeing it from lead with sulphuretted hydrogen and crystallization by evaporation, and still further by decolourizing the crystals with animal charcoal and recrystallization, the weight of the crystals being the per-

centage.[2] (*b*) Markownikoff[3] gives the following method of estimation: Boil 15 grammes of powdered tea with 500 grammes of water and 15 grammes of calcined magnesia for some time ; filter the decoction, wash the residue, and again filter ; mix the liquids together ; mix in the filtrate a known weight of calcined magnesia, and evaporate to dryness ; the residue contains the impure theine plus the magnesia ; weigh it. To separate the theine, exhaust the residue with hot benzol, filter, and evaporate the solution ; pure theine is left behind, and can be weighed and estimated. (*c*) In the examination of leaves (such as those suspected to be *spent* or not genuine tea-leaves), to ascertain the presence of theine the *sublimation method* may be used. A few leaves are placed in a watch-glass, covered by another watch-glass, and fixed on a wire support about 7 centimetres above a source of heat.[4] The upper glass will shortly show numerous droplets of condensed fluid, in ten minutes fine needle-shaped crystals of theine will appear, and in fifteen minutes a good crop for microscopic examination. The method is equally applicable to coffee, maté, guarana, and kola-nut. Exhausted tea-leaves, coffee, etc., treated in this way will show no sign of such crystals ; on the other hand, the test is so delicate that a small portion of tea-leaf weighing 0·0011 gramme gave distinct crystals after ten minutes' heating.[5]

Theine is a powerful poison in large doses ; $\frac{1}{2}$ gramme causes a quick pulse, nervous excitement, slight delusions, and, lastly, a desire for sleep. Smaller doses cause sleeplessness, irritability of the bladder and bowels, trembling of the extremities, uneasiness, restlessness, anxiety, and other signs of cerebral or nervous distress, followed by a dreamy sleep.

Tannin is stated by Parkes to average 15 per cent. and by König 12·36 ; it, however, varies greatly. Wigner[6] has found as much as 33 per cent. in choice Assam, 39 in young Hyson, and 42 in caper. Tea also contains gallic acid, oxalic acid, quercitin, resinous and waxy matters, which are extracted by infusion or decoction.

The **essential oil** is yellow, and has a strong odour of tea ; it has a specific gravity lower than that of water, and it solidifies on exposure to cold. Green tea contains a greater proportion of ethereal oil, theine, and tannin, than black.

As a beverage an infusion is prepared by adding two teaspoonfuls to 1 pint of boiling water, and allowing it to stand five minutes ; it is then poured off. Most Europeans sweeten it with sugar, and the addition of cream increases its deliciousness. The above is of sufficient strength for most persons if the tea is of fair quality ; longer standing spoils the aroma, draws out the tannin and other astringent principles and colouring matter, makes the infusion rough and bitter to the taste, unwholesome, and adds little to the refreshing qualities of 'the social cup.' The water should be fresh boiled, and ought not to be kept simmering before using it, as such water never makes good tea ; and to insure the temperature when it is poured on the leaves, the teapot ought to be first washed out with boiling water. The infusion contains glucose, albumin, more or less tannin, theine, and the volatile oil ; it is of slight nutritive value, but it increases respiratory action, and has a decidedly invigorating and restorative effect on the nervous system in general, and the intellectual faculties in particular. It stimulates the general circulation, in consequence of which the arterial system of the brain is quickened, to the relief of headache, dulness, lowness of spirits, and melancholy, which effects are due to theine and essential oil.[7] An infusion of tea differs from that of coffee in containing iron and manganese, which cannot be without their influence upon the system.

These stimulants (tea, coffee, cocoa) yield a remarkable series of substances which belong to the alloxuric or purin bodies, analogous to uric acid and xanthin ; thus theine or caffeine is tri-methyl-xanthin, and theobromine is di-methyl-xanthin, and they can be prepared synthetically from xanthin :

Hypoxanthin	$= C_5H_4N_4O$.
Xanthin	$= C_5H_4N_4O_2$.
Uric acid	$= C_5H_4N_4O_3$.
Theobromine	$= C_7H_8N_4O_2$.
Theine or caffeine	$= C_8H_{10}N_4O_2$.

Hypoxanthin and xanthin are found in animal tissues as a result of tissue metabolism, decomposition of nucleo-proteids, and the oxidation of nitrogenous substances from the tissues or foods consumed, and are eliminated from the body as uric acid, which

is also the form in which caffeine and theobromine are eliminated. Tea, coffee, cocoa, maté, and guarana, by virtue of these active principles, directly excite the secretory activity of the kidneys, thereby increasing the elimination of nitrogen in the form of urea and uric acid. In this respect they form a contrast to the saline diuretics, which only appear to increase the discharge of water and salts from the body.

An excess of tea is always deleterious, although some persons are more subject to its influence than others. Common symptoms are indigestion, heartburn, flushing of the face and excessive nervousness, neuralgia, headache, insomnia, and other nervous troubles. Green tea is more likely to produce a train of nervous symptoms than black. It should never be taken with or immediately after a meal of meat, as the tannin has a tendency to retard digestion by coagulating albumin, and thereby promotes flatulence and dyspepsia.

The **ash of tea**, according to Zoller,[8] contains—potash, 39·22 per cent.; soda, 0·65; lime, 4·24; magnesia, 6·47; oxide of iron, 4·48; manganese, 1·03; phosphoric acid, 14·55; carbonic acid, 24·3; chlorine, 0·81; silica, 4·35; total, 100·00.

Adulterations.—Quartz, sand, and the magnetic oxide of iron, are found in the dust. The facings of green tea consist of Prussian blue and French chalk—a thin film of graphite may sometimes be found;[9] but artificial colouring is fast disappearing.

Many leaves have been used as adulterants, such as hawthorn (*Cratægus oxyacantha*), sloe (*Prunus communis*), beech (*Fagus sylvatica*), *Camellia saxanqua*, *Cloranthus inconspicuus*, also bramble, raspberry, plum, gooseberry, elder, and willow, besides *spent* tea-leaves, which have been 'faked' with astringents, such as catechu and soluble salts of iron, or moistened with starch and rolled up to look like ordinary leaves. There are various methods of detecting fraud, as by the *sublimation* method, to determine the presence of theine. Foreign leaves are detected by heating a small quantity of tea with water until the leaves are sufficiently moistened to permit them to be unfolded, spread upon glass, and the serrations at the edge, the venation, and stomata, examined by a magnifying glass.[10] A further method used is the determination of the amount of ash. According to Zoller, genuine dry tea-leaves contain 5·75 per cent., but spent tea-leaves much less,

ash, while most of the leaves used for adulteration contain more ash than the genuine leaves. Wanklyn also points out that the solubility of the ash varies; he takes 2 grammes of the leaves and burns them in a platinum dish until the ash is gray; he then allows the dish to cool, and weighs it to ascertain the amount of ash; he afterwards heats the ash with boiling water and filters it, evaporates the filtrate to dryness, and again weighs it to ascertain the amount of insoluble ash.

Tea Cigarettes.—A habit of smoking tea in cigarettes has arisen amongst those, especially ladies, who demand artificial stimulants. In many cases the use of these cigarettes is taking the place of the morphine, cocaine, or strychnine habit—that is to say, they are replacing one evil by another. Green tea, or a mixture of Souchong and Hyson, is used in many cigarettes. The smoke contains three parts of the theine of the tea unaltered, besides the ethereal oil, hydrogen sulphide, ammonia, and carbonic acid.[11] The effects of the habit are so serious that it ought to be discouraged, and it has been suggested that the sale of the cigarettes should be made a penal offence. It is said that if the taste for them is developed the smoker is doomed. They cause the head to swim, and a desire to clutch things to prevent falling; this is followed by a dazed, semi-stuporous condition and extravagant visions. The secondary effects are often disastrous; they cause insomnia and nervousness, and frequently serious mental disease or a break-down of the nervous system is induced by smoking them, for which numerous ladies have had to be treated in sanatoria.[12]

Substitutes used for Tea.—In many countries various leaves are used, not to adulterate, but as substitutes for tea: thus, Labrador tea consists of the leaves of *Ledum latifolium;* Madagascar tea, or Fahum, of the leaves of an orchid. In Africa various plants having stimulating properties are used as tea. Bush tea consists of the leaves of Cyclopia (N.O. Leguminosæ), which has a strong aromatic odour like China tea; 'stekelthee,' of the leaves of another African leguminous plant; Caffre tea, of several species of Helichrysium (N.O. Compositæ), which have an agreeable smell and are favourites with the natives; 'Dornthee,' or Cape tea, of the leaves of Cliffortia (N.O. Rosaceæ).[13] *Kat* or *Catha edulis* (N.O. Celastrinæ), is the tea of Arabia, a

shrub much used, and forming an important article of commerce among the Arabs. The twigs and leaves of the shrub are made up into bundles of various size and quality. It contains a principle called **katine**, allied to caffeine, and it is used in a decoction; its effects are similar to those of coca (*q.v.*); it is a powerful stimulant to the nervous system, banishes sleep, restores the physical forces, and sustains the system under great muscular activity.

Coffee, the fruit of *Caffea Arabica*, N.O. Rubiaceæ, is a native of Arabia and Abyssinia, but is grown extensively in many districts of tropical countries; it is imported from Jamaica, Malabar, Rio, Costa Rica, Java, Ceylon, Egypt, Arabia, and the East Indies. The kinds best known to commerce are called Mocha, Mysore, Mysore - Peabody, Costa Rica, Ceylon, and Plantation, the order given being somewhat that of their relative value. While Mocha is the best coffee, most comes from Java and Central America; about 100,000,000 pounds are consumed annually. The tree is a shrub about 15 to 20 feet high, which bears white and sweet-scented flowers. Coffee consists of the fruit, which is a small red fleshy berry about the size of a small cherry, containing two seeds or beans in each; they are gathered when ripe, and the outer covering and pulp are removed; a pound of coffee is usually the product of more than one tree. Before using it, coffee is roasted and ground. The excellence of the beverage depends very largely upon the care and skill exercised during roasting: if it is too little roasted, it is devoid of flavour; if too much, it becomes acrid and has a burnt taste. During roasting the berry swells from the formation of gases, and a large quantity of water is driven off, some of the active principle is volatilized, and sugar changed into caramel; the cells containing the fat and nitrogenous elements are ruptured, and the aroma is developed. **Caffeol** ($C_8H_{10}O_2$) is also given off, together with some of the caffeine, carbonic acid, palmitic and acetic acids, pyrrol, methylamine, and hydroquinone.[14] It is best roasted at 210° F., and as the aroma is volatile, the infusion is more fragrant when the coffee is roasted immediately before use.

Composition.—Nitrogenous matters, 6·15 to 13·58 per cent.; fat, 3·98 to 11·6; cellulose, 8·6 to 16·1; ash, 2·1; caffeine, 0·5 to 2·05; water, 7 to 13·5.[15] It also contains the aromatic oil, caffeo-

tannin, sugar, gum, and salts. The infusion contains chiefly the caffeine, aromatic oil, salts, and colouring matter. The oil is a brown liquid developed during roasting; a single drop fills a room with the odour of coffee, and a mere trace gives the characteristic aroma to a quart of water.

Caffeine is the active principle ($C_8H_{10}N_4O_2$) isomeric with theine in tea and guaranine in guarana, and closely allied to theobromine in cocoa. It is slightly bitter, crystallizes in slender silk-like needles, and readily forms salts. Its presence and percentage in a given sample is determined in the same way as theine. The pure alkaloid and citrate are used in medicine, and either in this way or in the ordinary infusion caffeine is absorbed unchanged into the blood, and its chief action is on the nervous system and the kidneys (see 'Tea').

Various substitutes are sold for coffee, and Duchacek gives the following composition of some, which he compares with genuine coffee:[16]

	Fig Coffee.	Malt Coffee.	Chicory Coffee.	Ceylon Coffee.
Moisture	7·83	2·07	5·99	1·96
Soluble in water ...	70·99	41·93	69·67	26·06
Sugars	35·70	1·73	18·23	1·43
Dextrin	2·30	15·83	1·40	0·96
Caffeine	nil	nil	nil	1·12
Fat	3·07	5·24	2·23	15·02
Ash	4·47	3·19	5·88	3·65

Adulterations.—Coffee is most often adulterated with chicory; but many other substances are used, as dandelion roots, acorns, wheat, rye, peas, beans, the seeds of lupin, cassia, dates, and figs; also turnip, mangold, cabbages, burnt sugar and other colouring agents. None of these are deleterious, but they are poor substitutes for the genuine article, and do not contain the active principle and aromatic properties of coffee. The worst effect of such adulteration is the decrease in the percentage of caffeine in the mixture. **Chicory** (*Cichorium intybus*, N.O. Compositæ) contains no caffeine and no aromatic oil like coffee; but it sweetens and gives additional body, bitterness, and colour to it. The sugar in pure roasted coffee seldom exceeds 2 per cent., but in roasted chicory it may exceed 10 per cent. Wolff gives

the following as the *mean* composition of commercial samples :[17] Moisture, 12·3 per cent. ; ash, 5·8 ; sodium chloride, 0·22 ; iron, 0·12 ; lævulose and dextrose, 11·1 (7 to 14) ; inulin, 5·9 ; caramel, 13·4 ; aqueous extract, 60·1 ; cellulose, 9·1 ; salts, 1·9 ; nitrogen, 6·0. The inulin may reach 11 or even 16 per cent., but some of it is converted into lævulose during roasting.[18]

A large quantity of chicory root is cultivated for this purpose in England and Europe, and when it is carefully roasted and ground it has an appearance very much like coffee. The microscope is indispensable in detecting it, and reveals its presence by the coarse areolar tissue and long dotted ducts which are characteristic of chicory ; while coffee presents the oval cells of the testa and irregular networks of fibres containing the dark angular masses and oil globules which form the material of the berry. Another method of detecting chicory is to sprinkle some of the coffee upon water in a glass vessel ; the chicory rapidly sinks, but the coffee floats a considerable time, owing to the oil globules and gases developed during roasting. At the same time, each particle of chicory becomes rapidly surrounded by an amber-coloured cloud, which spreads in streaks throughout the water until the whole is brown ; with pure coffee no cloud is produced under fifteen minutes.[19] The adulteration of coffee by roasted grain, beet-root, and other things, is detected by the microscope and chemical tests for starch and caffeine.[20] Chicory often contains added sugar ; and roasted beet-root, which contains a larger proportion of sugar and yields more to water than chicory, is either mixed with it or used as a substitute. Roasted beet-root has the following composition : Water, 5·03 per cent. ; nitrogen, 1·63 ; fat, 0·7 ; sugar, 34·69 ; ash, 7·89 ; matters soluble in water, 49·5.[21]

The preparation of the beverage requires care to insure the best effects of the coffee. It may be taken as an infusion or decoction. The infusion is the best ; it should be made by putting the coffee in a strainer or muslin bag in the coffee-pot and pouring the water through it ; the water should be not quite boiling (210° F.), at which temperature the aroma is best preserved. Coffee made in this simple manner contains nearly all the strength and the fullest amount of the aromatic oil ; the addition of sugar, boiled milk, and cream, makes a delicious wholesome, and refreshing beverage. Those who boil coffee do so in ignorance of

its nature, and usually have the mistaken notion that the strength cannot be extracted without boiling; this is contrary to fact. By boiling or infusing the coffee in quite boiling water the fine aromatic oil is evaporated, mucilage extracted, and a deposit of some of the active ingredients takes place; the coffee is consequently flat and weak. It is true that the Arabs and Turks boil their coffee, but they do so only for a moment, and each cup is prepared by itself, and is much more like an infusion than a decoction. Orientals do not take sugar or milk with it; they drink it at all hours of the day and night, and give it to their visitors at all times; some of them appear to exist principally upon coffee and opium or haschish.

Coffee is an aromatic, refreshing, invigorating, tonic stomachic and stimulant; by it the digestive glands are stimulated and digestion indirectly assisted; it is laxative, dietetically wholesome, more stimulating than cocoa, but less sustaining. It has considerable influence over the nervous and muscular systems; it removes the sense of fatigue, and is an aid to persons undergoing fatigue in all circumstances. These effects are due mainly to caffeine; medicinally, this principle is useful as a cardiac stimulant and in dropsy, whether due to failure of the heart or disease of the liver or kidneys. Schroeder showed by experiments that the diuretic action is due, firstly, to its exciting the central nervous system, and, secondly, to its direct action on the kidney substance. Bruce says that in passing through the kidneys, not only is the watery secretion increased owing to the increased blood-pressure, but it stimulates the cells of the kidneys and causes increased excretion of waste matters, to the advantage of the consumer. It is valuable in heart disease, Bright's disease, liver disease, alcoholism, insomnia, nervous headache, neuralgia, collapse, epilepsy, spasmodic asthma, influenza, sea-sickness, and in opium-poisoning. The morning cup of coffee stimulates the brain, clears the intellect, removes languor, fatigue, headache, drowsiness, and faintness, by its influence as a nerve stimulant and restorative; the action of the heart is quickened, the general circulation stimulated and a feeling of well-being induced; the breathing is quickened, partly because of the strengthening of the heart's action, but also from the quickening of the movements of respiration and increased expiration of CO_2. It likewise stimu-

lates the secretions and movements of the alimentary canal. The skin partakes of the same beneficial effect, for not only does the liquid produce a sensation of warmth to the skin in a cold climate or weather, but it stimulates the sweat glands and increases the loss of heat by the skin, whereby a cooling effect is produced in warm weather or a tropical climate. Habit weakens the influence of coffee, tea, and other stimulants containing the same active principle; it is also observed that persons of a delicate or nervous idiosyncrasy cannot always drink coffee or tea, because they cause them to have palpitation of the heart or cardiac distress, nervous agitation, trembling, wakefulness, and sleeplessness; these symptoms may also occur in anyone who takes these beverages in excess, and they sometimes produce a species of narcotism.

MATÉ, or Paraguay tea, consists of the leaves of a species of holly, *Ilex paraguayensis*, N.O. Aquifoliaceæ, which grows abundantly in Paraguay, Chaco, Brazil, and other places in South America. The tree forms woods in some places; it grows to a height of 4 to 7 metres, with a trunk of about 20 centimetres in diameter; the bark is whitish, and the leaves oblong, cuneiform, obtuse, and finely dentate. Its use occupies a position in South America similar to that of Chinese and Indian tea in Europe; it was derived from the natives, who call it maté, and the quantity consumed is said to exceed 8,000,000 pounds a year. Throughout South America it constitutes the favourite drink of the inhabitants, who ascribe to it innumerable virtues. Its preparation is different from that of tea; the young branches and twigs are cut off and placed on hurdles over a fire until properly dried or roasted; the leaves from each branch are then removed and cut into small pieces or reduced to a coarse powder. The natives make the infusion in a gourd, and the fluid is drawn through a 'bombilla,' or small tube, into the mouth. It contains 0·5 to 1·85 per cent. of caffeine[22] and 0·77 per cent. of a yellow oil having an odour like the plant.[23] Its composition, according to Katz,[24] is as follows: Minerals, 7·24 per cent.; moisture, 9·38; nitrogen, 2·05; caffeine, 1·15; albuminoid matters, 10·75; fat and resin, 6·57; tannin, 7·74; soluble in water, 31·18. The salts contain a high percentage of magnesium and manganese, to which some of the physiological properties of the plant are due. The proportion of caffeine is by

no means large, but the oil which it contains appears to give some of the stimulating properties.

The action of maté places it in a position intermediate between tea and coffee. It acts chiefly upon the nervous system, but though it contains a moderate proportion of caffeine, it neither exalts the peripheral nerves like tea, nor the cerebral nerves like coffee. It is said to be a harmless beverage: it relieves fatigue, and conveys a feeling of lightness and energy which makes duty a pleasure; it is especially useful for those who have night duties to perform.[25] But when it is taken in excess, it contributes to indolence, drowsiness, and mental torpor, in the same way as other sedatives and narcotics.[26] It accelerates the heart and the movements of the alimentary canal; and is beneficial for many nervous affections, headache, migraine, nervous irritability, neuralgia, or insomnia, for which it may be taken to the extent of three or four teacupfuls a day prepared like ordinary tea.

Excessive and prolonged use of maté makes it an imperious necessity, such a gloominess following abstention from it that habitual drinkers would rather go without food than maté. It is also said to cause nervous affections of the heart, and gastric troubles, especially when it is sucked through a tube and the hot liquid comes into contact with the gastric mucous membrane; toleration is well established, however, by many persons.

Guarana, or Brazilian cocoa, is a preparation made in South America, consisting of the seeds of *Paullinia sorbilis*, N.O. Sapindaceæ, roasted and pounded into a stiff paste with water, formed into cylindrical rods, and dried in the sun. It contains 5 per cent. of caffeine, and is, therefore, much stronger than either of the foregoing; it also contains tannin, starch, and gum.[27]

As a beverage, 15 to 60 grains infused in boiling water is of undoubted value as a stimulant and restorative beverage, which is entirely due to its richness in caffeine. It is, however, principally used in the treatment of megrim or sick headache, and is well adapted for the nervous form of this affection, but is of very little use when headache arises from biliousness or gastric troubles. It has also been used in incipient phthisis, wasting diseases, and in convalescence from acute disorders, because it is considered to promote constructive metabolism. At the least it has the power of checking the waste of the tissues.

Kola or goora nut, the product of an African tree, *Cola acuminata*, N.O. Sterculiaceæ. It is a highly invigorating and stimulating article of food, highly prized as a condiment and aid to digestion by the natives of Africa, the West Indies, and Brazil. The composition of ten varieties of kola-nut averages: Water, 13·5 per cent.; total nitrogen, 1·53; caffeine and theobromine, 2·08; ethereal extract, 1·35; starch, 45·4; tannin, 3·79; cellulose, 7·0; other non-nitrogenous matters, 18·21; and minerals, 2·90.[28] The active principle is **kolanine**, a glucoside, which under the influence of an enzyme in the nut splits up into caffeine, kola-red, and glucose.[29] The fresh undried nuts contain very little kolanine. It is developed in them under the influence of light, air, warmth, and moisture, by the action of an enzyme, **laccase**. Dried Congo and Dahomey nuts contain most kolanine, and Indian least; and caffeine and theobromine are developed from it equivalent to one-fifth of its weight.[30] Kola increases the power of endurance for mental and physical strain, or it removes the sense of fatigue after such strain, and it enables the body to bear fatigue during prolonged fasting. The great stimulant and restorative effects are acknowledged by the medical faculty, but the opinion upon its secondary effects is not unanimous, some maintaining that it has no evil effect whatever, others that it has deleterious effects similar to narcotics. There is certainly a danger of creating a 'habit,' as with other stimulants, which should be guarded against. The stimulating effect is similar, but superior, to that of tea and coffee, being more enduring. It moderates the waste of the tissues, *diminishes* the elimination of nitrogen and phosphates, and checks rather than increases the action of the kidneys.[31] Boa attributes the longer duration of stimulation by kola to the slower absorption of its active principles.[32]

The following modes of preparation are recommended:

(*a*) Take a teaspoonful of kola powder, mix it evenly with a little cold water, add water to ½ pint, and boil it five minutes in an open pan; pour it into a jug and allow five minutes for it to settle.

(*b*) Kola elixir[33]: Fluid extract of kola, 50 parts; glycerine, 60 dilute alcohol, 60; Malaga wine, 500; simple syrup, 200; tincture of vanilla, 20; distilled water to make 1,000. Mix. Dose, a liqueur-glassful three or four times a day.

Kola is of value medicinally as a tonic and stimulant in debility, neurasthenia, and depressed states of the nervous system generally; in alcoholism and morphinism; diarrhœa of a chronic character; migraine; and as a heart stimulant in cases where digitalis is inadmissible, as fatty heart, fatty degeneration, dilatation, and bradycardia.

Cocoa and chocolate are made of a paste from the bean of *Theobroma cacao*, N.O. Sterculiaceæ, roasted, ground, and flavoured with cinnamon, vanilla, cloves, or other aromatic substances, and mixed with sugar.

The cacao-tree is a native of Mexico and Columbia, where it grows wild, and in some places, as the banks of the Amazon, forms entire forests. It is, however, cultivated over a large portion of the tropics, and grows up to an elevation of 1,700 feet above sea-level. The finest qualities are grown in Central America (Brazil, Peru, Carracas, Guatemala, Venezuela, Granada, Guayaquil, Ecuador, Suranim) and in Trinidad and Ceylon; but it is grown also in the West Indies, Madagascar, the Mauritius, the Philippines, Bourbon, and some parts of East India, Africa, and Australia. Humboldt found it growing freely in Carracas and Guatemala, and Linnæus called it **theobroma** (*θεόςβρομα, the food of gods*). It is an evergreen tree, growing 15 to 30 feet high. The leaves are 18 to 20 inches long, bright green, and lanceolate. The flowers consist of five small yellow petals upon a rose-coloured calyx, and appear at all seasons, followed by fruit. The fruit is an elongated oval body, 7 to 9 inches long and 3 to 4 broad, consisting of a thick, smooth rind, of yellow, red, or purple colour, enclosing five cavities, in which are the seeds or beans, whose total number is from twenty to forty, surrounded by a fibrous pulp. The rind gradually shrivels and dries up into a weak red or gray-brown shell, in which the seeds are loosely enclosed when they are ripe. The seeds are 2 to 2·5 centimetres long and 1 to 1·5 centimetres broad. Although flowers and fruit occur at all seasons, two periods (May to June, October to November) are chiefly observed for gathering them.

The ripe pods only are gathered, and are opened on the spot to remove the beans. The latter are taken to the sweating-house. 'Sweating' is a species of fermentation in which certain changes

take place. Fresh beans are of crimson colour, somewhat oily, and of disagreeable taste. They are put in barrels or boxes and covered with plantain-leaves in a close room from four to seven days. During this time their temperature rises to about 140° F. Some water and CO_2 are given off, their colour changes from red to brown, they lose their disagreeable flavour, and develop the aromatic odour so highly prized in chocolate. They are then turned out, picked over, and rubbed to remove any fibrous pulp or foreign matter adhering to them. They are afterwards spread on a tray and covered with red earth for another day to complete the fermentation; the red earth assists in absorbing moisture and mucilage, and gives to the beans a red colour. Finally they are again rubbed and spread upon trays to dry in the sun, care being taken that they are not shrivelled.[34]

In the manufacture of cocoa the after-process consists in roasting the beans by direct heat or high-pressure steam. They are transferred to a machine, which cracks the hard, thin skins or husks and removes them by 'winnowing.' The heat breaks the thin-walled polygonal cells of the kernels, and some of the fat is abstracted; they are then reduced to a powder or paste, and mingled with starch, sugar, or other ingredients.

The composition of commercial varieties of the bean is as follows: Fat, 42·0 to 57·4 per cent.; theobromine, 0·63 to 2·20; starch, 7·56 to 16·53; ash, 2·2 to 3·75.[35] This is the result of the analysis of twenty-three trade brands, and the following table shows the composition of individual varieties:[36]

COMMERCIAL VARIETIES OF COCOA.

Source.	Bahia.	Surinam.	Java.	Trinidad.	Ariba.	Carracas.	Granada.	Roasted Trinidad.	Tobasco.	Machalle.	Roasted Carracas.	Maracaybo.	Average.
Fat or cocoa butter ...	42·1	41·0	45·4	43·6	43·3	36·8	44·1	41·8	50·9	46·8	37·6	42·2	42·9
Theobromine	1·08	0·93	1·16	0·85	0·86	1·13	0·75	0·95	1·15	0·76	0·76	1·0	0·97
Albuminoids	7·5	10·5	9·25	11·9	10·1	10·5	9·7	12·0	7·8	12·6	12·3	11·5	10·5
Glucose ...	1·0	1·2	1·2	1·3	0·42	2·7	1·8	1·4	0·9	1·6	1·7	1·0	1·4
Saccharose...	0·51	0·35	0·51	0·32	6·37	1·5	0·55	0·28	2·7	0·46	0·51	1·3	1·2
Starch ...	7·5	3·6	5·1	4·9	1·5	3·8	6·2	5·7	3·5	1·35	6·0	1·6	4·2
Lignine ...	7·8	3·9	6·1	5·6	4·6	3·2	5·5	5·8	6·4	5·9	9·0	7·1	5·9
Cellulose ...	13·8	16·2	13·8	13·0	14·0	16·3	13·4	19·6	12·5	11·3	11·6	17·3	14·4
Extractive...	8·9	13·5	8·9	8·3	9·0	12·7	9·7	5·8	9·2	9·0	9·2	6·7	9·3
Moisture ...	5·9	5·5	5·1	6·3	5·9	6·6	5·2	2·6	1·5	5·8	5·6	5·6	5·1
Ash	3·6	3·0	3·3	3·6	3·7	4·3	2·7	3·7	3·0	4·1	5·0	4·1	3·7

The fat or cocoa butter, **oil of theobroma**, is a hard, fatty substance of yellowish-white colour, having the odour and taste of cocoa. It melts at 29° or 30° C., and consists of cocoa-stearin, with a little olein and palmitin and traces of lauric and arachic acids. It does not become rancid on keeping if it is pure. Commercially it is sold for many purposes, and is sometimes adulterated with tallow, paraffin-wax, and other substances.[37] **Theobromine** can be obtained from cocoa by treatment with lime and alcohol. The natural starch in cocoa consists of exceedingly small granules, nearly spherical, and having a small central distinct *hilum*, which is usually surrounded by one or two circular lines. The hilum may be simple, straight, curved, fissured, or stellate; otherwise the granules are smooth and unmarked, but are sometimes triple or quadruple. They are distinguished from rice or other starch, which is sometimes mixed with commercial cocoa, by their spherical shape and smaller size. The granules of nearly all commercial starches are larger than those of cocoa, which renders their recognition under the microscope easy when used for adulteration.[38]

Cocoa, by reason of its composition, is a nutritious food, and, although not so stimulating, it is more sustaining than tea or coffee. In prepared cocoa more than half the proteid is digested and most of the fat is absorbed.[39] In its natural condition cocoa is somewhat indigestible, being too rich in fat. It must be properly prepared to make it acceptable to the stomach, for which purpose it is roasted and ground and the quantity of fat reduced. To reduce the proportion of fat, (*a*) the roasted and ground cocoa is mixed with starch and sugar, or (*b*) before grinding the cocoa it is heated and a varying proportion of fat removed by pressure. In the former method it is obvious that *no fat is removed, but the cocoa is diluted.* Many commercial cocoas formerly consisted of starch and sugar flavoured with cocoa. The latter method is the best, and probably most in use at the present time. By this means from 40 to 75 per cent. of the oil can be removed, which is not objected to by most people, as they dislike greasy cocoa; and the nourishing and stimulating properties are allowed to remain, and are somewhat concentrated. One popular form of prepared cocoa contains — fat, 28·12 per cent.; theobromine, 0·95; natural starch, sugar, and

fibre, 40·85; albuminoids, 21·34 (including 6·61 soluble and 14·73 insoluble); minerals, 4·94; moisture, 3·80; total, 100 per cent.[40] In the natural cocoa the fat varies from 42 to 57 per cent.; but a well-prepared cocoa should contain only 30 to 35 per cent., about $\frac{1}{3}$ to $\frac{1}{2}$ having been removed. If the amount of fat in a sample is very small, there is a danger that such a low percentage may be due to dilution instead of abstraction. The Society of Analysts fixed 20 per cent. as the *minimum* of fat which prepared cocoa should contain. Some prepared cocoas are very much diluted with starch and sugar. These adulterations are not injurious, but the cocoa contains less of the essential properties, and is therefore less stimulating and invigorating. In such preparations the natural fat is not reduced in amount, and it is necessary to add some kind of alkali, such as soda, potash, or ammonia, to saponify the fat, thereby reducing greasiness, darkening the colour, and apparently increasing the strength of the cocoa. Arrowroot and potato starch are very commonly used as diluents, and their presence can be recognised under the microscope; and various colouring matters have been added, such as Venetian red, umber, peroxide of iron, and even brick-dust.

Cocoa nibs consist of the seeds simply removed from the husks, crushed, and roasted. **Flake cocoa** is made of the nibs ground in a particular way.

CHOCOLATE consists of the roasted and sweated beans, from which most of the fat is exhausted, mingled with various flavouring agents, as vanilla, musk, cinnamon, cloves, and almond. Usually the cocoa nibs are ground in a heated mill until the fat is extracted, and the residue is mingled while soft with 25 per cent. of sugar, and 5 to 10 of sweet almond, 1 or 1·5 of vanilla, 0·5 of cinnamon, and 0·2 of cloves. The sugar and flavourings vary in the best chocolate, and this constitutes the main difference in good samples. The paste in the interior of chocolate creams consists of sugar, gum, starch, condensed milk, and other things, which do not detract from their value. Many inferior chocolates are made from which cocoa is practically absent, the paste consisting of the powdered husks and sugar, sometimes coloured, and the odour and flavour of chocolate is increased by an ingenious mixture of cocoa fat.

Vanilla, which is so largely used in the manufacture of cocoa and chocolate, is the fruit of *Vanilla aromatica et planifolia*, N.O. Orchidaceæ. Native in Brazil, and grown in many places where cocoa is cultivated. It grows upon cocoa and other trees to a height of 15 to 25 feet. The leaves are thick and fleshy.

Coca, the leaves of *Erythroxylon coca*, N.O. Erythroxylaceæ. A South American plant, grown largely on the Andes of Bolivia and Peru. The annual consumption in South America is said to exceed 100,000,000 pounds. It has been an incalculable blessing to the natives in all ages. Its physiological action places it in the same category as tea and coffee, but its effects are more strongly marked. Its power of preventing fatigue or of removing it has been well established. Sir R. Christison made many experiments with it.[41] He found during great exertion that fatigue was lessened and hunger and thirst prevented by it, and the mental faculties were liberated from the dulness and drowsiness which follow great bodily activity; that the waste of the tissues was lessened by its use, although it did not diminish perspiration, nor were the digestive functions impaired by its use. The South American usually consumes coca by chewing it with a trace of lime or chalk. Its effects are those of a stimulant and restorative; while quickening the heart and respiration, it prevents muscular and nervous exhaustion and diminishes the consumption of the bodily tissues, and enables a person to bear up against bodily fatigue with less food than usual, or even without any. It enables persons to climb high mountains without the difficulty of breathing customary in ascending from a low to a higher plane. The mental faculties are, however, said to be less stimulated by coca than by tea or coffee.

Composition. — Coca-leaves contain 0·2 per cent. of **cocaine** ($C_{17}H_{21}NO_4$), an alkaloid occurring in colourless monoclinic prisms, having a bitter taste, which is followed by a tingling sensation and numbness; secondary alkaloids are **ecgonine** and **Iso-atropyl cocaine**; it also contains **hygrin**, which gives aromatic properties to the leaf, together with coca-tannin and coca wax.[7]

The physiological effects of coca are due to the alkaloids, and are analogous to those of tea and coffee. It may therefore be used in the form of an infusion, wine, or elixir, as a general

stimulant to diminish or remove the exhaustion due to muscular exertion and mental fatigue from overwork, worry or trouble, and in convalescence, nerve exhaustion, neurasthenia, nervous and muscular debility; it may also be usefully employed in cases of insomnia, in gastric and intestinal indigestion, in which food is not properly assimilated, in cachectic conditions due to many diseases and blood poisons, and to combat the effects of opium and alcohol. As in the use of other stimulants, a habit may be formed which is comparable in its results with the worst moral effects of opium-eating, morphinism, or alcoholism; but these cases are rare, except when cocaine is taken hypodermically for long periods and in excessive doses. Even chewing the leaf in excess will bring on various disorders, and the desire for it increases to such an extent with indulgence that a confirmed coca-chewer is said to be never cured.[42] Of the alkaloids, iso-atropyl cocaine is a powerful heart poison, and cocaine will in time not only benumb the cerebral faculties, but reduce the subject to a state of complete mental imbecility, unable alike to perform his professional or social duties, and more or less unfitted for the companionship of his fellows. It is a good servant, but a bad master! The increasing use of cocaine in the treatment of disease points to the necessity for care in prescribing it. 'A delicious beatitude' follows its application for hay-fever and other diseases, which has a tendency to make the patient a slave to the habit. Symptoms due to the habit usually begin with disorders of digestion, as loss of appetite and emaciation. But its chief pathological effect is, as indicated, upon the nervous system, in which some form of degeneration takes place which induces insomnia, tremors, inco-ordination; even convulsions, paralysis, hallucinations or delusions, and delirium or insanity, may follow.[43] It behoves all medical men to be extremely careful how and for whom they prescribe it, and to take especial care that the patient does not have a free hand in its use.

An agreeable coca essence or cordial may be made like an ordinary tincture by macerating 2½ ounces of the leaves in 1 pint of proof spirit, with the addition of ginger, cloves, allspice, or other aromatics; two teaspoonfuls added to a tumblerful of warm sweetened water makes a good beverage for all times of the year.

Coca wine may be made thus: Soak 4 ounces of ground coca-leaves in 16 ounces of hot water for three hours; then add 64 ounces of port wine; percolate 56 ounces; and in it dissolve the sugar, add 6 ounces of alcohol, strain, and make up to 64 ounces with port wine. Each ounce represents 30 grains of leaves.

OPIUM is the juice of the unripe capsules of the white poppy, *Papaver somniferum*, N.O. Papaveraceæ; it is obtained by the incision of the capsules, when the milky juice exudes and dries by evaporation from exposure to the air and sun. Opium is imported from the Levant as Turkey or Smyrna opium; from Constantinople, a variety inferior to the former; from Egypt, Persia, and India; and some is also made in France and England. It consists of round, flattened, irregular, soft or putty-like masses of reddish-brown colour, with a bitter taste and characteristic odour; and the variety from each country has peculiarities by which it is known commercially.

Opium is a complex substance, containing no less than twelve alkaloids, two organic acids, resin, gum, extractive and odorous matters, besides other constituents of plants. The most important alkaloid is **morphine**, which forms 7 per cent. in inferior varieties and 10 or 12 per cent. of good Smyrna opium. The action of opium depends chiefly on morphine, which has a sedative influence on the brain and nervous system, relieves pain, and produces sleep; codeine, thebaine, and other alkaloids, may, however, cause convulsions, and so exceed the sedative effect; but these are points which need not be considered here.

As a narcotic stimulant it is used enormously by all Oriental races. It produces an intoxication which is said to transcend the excitement due to alcohol, in the feeling of exaltation, the sense of happiness and comfort, the brilliance of the imagination, and the increase of mental vigour. This is not unalloyed, for the ideas usually become grotesque, extravagant, unreal, and dreamy; exaltation is followed by great depression, the nerve centres are dulled, the mental faculties blunted, the consumer becomes lethargic, apathetic, and, if the dose is large enough, falls into a deep sleep.[7] It is smoked in a pipe, chewed, taken in pills, laudanum, and as morphine. Its excessive use in India has

caused many attempts to reduce its production or the means of obtaining it. In Europe its consumption by eating or smoking is not common; but isolated instances occur, and morphinomania is not rare. The consumption of opium in the fen or malarial districts, fostered by its curative powers in intermittent and other fevers, was formerly great. The habitual opium or morphine taker is generally unreliable; his moral faculties are more or less depraved, his mental capacity, except when under the influence of the drug, dull and torpid. It deranges digestion, causes a deficiency in the biliary and glycogenic functions of the liver, and suppresses other glandular secretions; metabolic activity is reduced, respiratory movements weakened, and the general blood-pressure lowered.[7] Altogether, the confirmed opium-taker or morphinomaniac is a miserable specimen of humanity.

HASCHISH, bhang, or Indian hemp, consists of the green tops, including the flowers and fruit, of the female plant *Cannabis sativa*, N.O. Cannabinaceæ. It is extensively used in the East. **Haschish** is the Arabian name given to the dried tops of the plant grown in Egypt, and gathered before the seeds come to maturity; used throughout Turkey and Persia. **Gunjah** is the chief Indian form, consisting of the dried tops of cannabis, sold in the bazaars for smoking; it is in compressed, rough, dusky-green masses, containing the flowers, fruit, and smaller leaves; of an agreeable narcotic odour, resinous, and adhesive to the touch. **Bhang** is also an Indian preparation, consisting of the larger leaves and capsules; it is the cheapest form, used for smoking, chewing, making an intoxicating drink, and confections. **Majoon** is a confection or sweetmeat of green colour, consisting of cannabis or bhang compressed into small cakes.[44]

Cannabis indica contains an amorphous resin in abundance, an active principle **cannabinon**, a glucoside **cannabin**, two or more alkaloids, and **cannabene**, a volatile oil.

The natives of the Turkish Empire are more addicted to the use of **haschish** than of opium. The effect is similar in many respects, but haschish is preferred; they smoke the dried leaves, or make it into a cake, or mix it with tobacco and smoke it in a hookah; they likewise drink the expressed juice, or make a beverage of it.[45] The hookah is in general use among the

Mohammedans; both sexes smoke it, and children learn its use at an early age.

The general effects may be stated to be exhilaration, intoxication, and hallucination. Exaltation is the primary effect, with ideas of grandeur and magnificence, wealth and luxury, and other hallucinations; the consumer loses his personality, becomes some exalted person in some place other than he is, hears and sees things which exist only in his imagination, and has many other pleasurable ideas and feelings worthy of a place in the 'Arabian Nights' or other works of imagination.[45] The individual afterwards becomes deliriously noisy or falls asleep. The after-effects are by no means as pleasurable. The exaltation and intoxication are due to cannabinon, the succeeding muscular excitability and delirium to **tetano-cannabine**, which is a convulsant (Bruce). Persons unaccustomed to it are sometimes maniacally excited even to violence, and have redness and inflammation of the eyes. The use of this narcotic cannot, therefore, be countenanced as a useful article any more than opium, and should be discouraged whenever it is met with. Its value and effects as a drug have no place in a volume of this character.

Betel is a species of pepper, *Charica betle*, N.O. Piperaceæ, and is another stimulant narcotic, the consumption of which is carried on to an incredible extent in the East. The leaves of the plant, with a small piece of the nut and a little lime, are masticated; the taste is hot, acrid, astringent, and aromatic; it tinges the saliva red and stains the teeth; it is consumed by both sexes as a stimulant, and it produces a feeling of exhilaration and endurance of fatigue.

Ginseng (Panax, N.O. Araliaceæ) is much used as a chewing material, and is supposed to have mild stimulant properties; it is much used and praised by the Chinese, who have called it 'the pure spirit of the earth.' There are two species, the true ginseng (*P. schinseng*), which grows in Northern Asia, and an American species (*P. quinquefolium*), which is largely imported into China. The root is wrinkled, yellowish-white, has a sweetish aromatic, slightly bitter taste, and feeble odour; it is similar to liquorice-root; is rich in gum, starch, and sugar, and also has a little resin and an essential oil. It is demulcent, feebly tonic, and slightly stimulant; it is used regularly by many people, and

is administered for many ailments, but its extraordinary virtues only exist in the minds of the Chinese.

Tobacco (*Nicotiana tabacum*, N.O. Solanaceæ). According to modern statistics, the average consumption of tobacco per annum by each inhabitant is as follows: Netherlands, 3,400 grammes; United States, 2,110; Belgium, 1,552; Germany, 1,485; Australia, 1,400; Austria and Hungary, 1,350; Norway, 1,335; Denmark, 1,125; Canada, 1,050; Sweden, 940; France, 933; Russia, 910; Portugal, 850; *England*, 680; Italy, 635; Switzerland, 610; and Spain, 550 (*Medical Record*, December 21, 1901).

Tobacco is a poison in every form in which it is used; but use inures the individual to its effects, as it does to those of opium and other narcotics. The active principle is **nicotine** ($C_{10}H_{14}N_{12}$), an acrid, oily, volatile liquid, of pale amber colour, smelling strongly of tobacco; it can be resolved into **nicotina**, an alkaloid in the form of malates and citrates; and **nicotianine**, or tobacco camphor, which is a concrete volatile oil. There are other principles besides nicotine in tobacco. Pictet and Rotschy[46] extracted from 10 kilos of crude tobacco juice 1,000 grammes of nicotine, 20 grammes of nicoteine, 5 grammes of nicotinine, and 1 gramme of nicotelline, from which it is evident that nicotine is the principal agent, although the others probably have deleterious effects or become decomposed into secondary substances. The proportion of nicotine varies according to place of growth, soil, and other circumstances. French tobacco contains as much as 7 or 8 per cent., Kentucky and Virginia 6 or 7, Havanna not more than 2 per cent. Sinnbold's analyses give the following results: European cigars contain 0·648 to 2·967 per cent. of nicotine; Havanna cigars, 0·841 to 2·241; cigarette tobacco, 0·801 to 2·887; and pipe tobacco, 0·518 to 1·584.[47]

The physiological effects of tobacco are—(*a*) short stimulation of the central nervous system, followed by depression; (*b*) similar stimulation of the sympathetic nerves, followed by a lasting paralysis; (*c*) an action, like that of curare, on the terminal nerve-plates of the motor nerves in the muscles, also followed by paralysis. The heart is at first slowed and its contraction prolonged; the blood-pressure is raised by constriction of the arterioles, due to excitation of the vaso-motor centres in the peripheral ganglia; at a certain stage, however, this system is

paralyzed and the blood-pressure is no longer affected by it; motor paralysis is induced by its action on the intramuscular part of the nerves.[48] Other effects are trembling, giddiness, headache,[49] salivation, contraction of the pupils, convulsions, paralysis, etc.[50] That nicotine, the oily fluid containing the two alkaloids, is a powerful poison cannot be denied. The active principle in the smoke of a single cigar suffices to produce convulsions, paralysis, and death in a frog. A drop of nicotine near the beak of a canary will kill it; two drops on the tongue will kill a terrier dog in a minute; two drops on the tongue of a cat caused convulsions and death in two minutes; and a mastiff dog was destroyed in five minutes by the application of ten drops in the same manner. Death was always preceded in cases seen by the author by convulsions of a tonic character, and rigor mortis set in at once. In man, death has followed the injudicious application of a *quid* of tobacco to stop the bleeding of a wound; the application of nicotine on the point of a needle to a decayed tooth caused serious collapse, and the use of an infusion of tobacco as an external application in skin diseases, and an injection into the bowels for intestinal obstruction, have caused death; on the other hand, recovery is recorded after the injection of an infusion made from half an ounce of snuff and an infusion made from five tobacco-leaves.

The symptoms of **acute nicotine-poisoning** are observed when a person smokes a pipe or cigar for the first time; there is confusion of the mind, giddiness, nausea, vomiting or purging, trembling of the limbs, faintness, feeble pulse, and a cold clammy sweat, which are the signs of shock or collapse as the result of a profound impression on the nervous and muscular systems. These symptoms have been observed in a man who was induced to chew a piece of 'twist tobacco' to relieve him of toothache. When the dose is a large one, the breathing becomes difficult, the vision dim, and convulsions occur; death, preceded by more or less paralysis, may take place in fifteen to thirty minutes from tobacco, or in three or four minutes from the use of nicotine.

By custom, most people become inured to the influence of nicotine in tobacco-smoking, snuffing, or chewing. *The moderate use of tobacco* has a soothing and beneficial effect upon the nervous system of the man of business; 'it soothes and cheers the weary

toiler and solaces the overworked brain'; that it has a stimulating effect upon the cerebral functions can scarcely be conceded, although it temporarily increases the flow of blood through the cerebral arteries and may thereby spur a weary brain, and by the free supply of oxygen and food assist that organ in its work. Many men of great intellect have been large smokers. In like manner, the after-dinner pipe or cigar aids digestion by increasing gastric secretion and peristalsis, and has a hygienic effect in stimulating the corresponding intestinal movements.

The effects of *excessive use of tobacco,* or chronic nicotine-poisoning, are best understood by reference to its physiological action. The most immediate effect of tobacco or nicotine in any form is to make the heart beat slower, but more powerfully; this is followed by an acceleration of the heart's pulsations by 30 to 50 per cent., due to the influence of nicotine upon the cardiac branches of the pneumogastric nerve. Nicotine suppresses or paralyzes the inhibitory fibres of that nerve, and there is consequently an acceleration of the action of the heart. It also paralyzes the sympathetic ganglia and prevents the passage of impulses through them, and consequently the vasomotor nerves are paralyzed. Interference with the functions of the vasomotor nerves, especially those in the abdomen, causes dilatation of the arterial system and lowering of the blood-pressure. The vertigo, dizziness, and trembling are, in the first instance, a consequence of diminished supply of blood to the brain, and later of the toxic effects of nicotine on the nerve cells. The effect of a pipe of tobacco on the stomach is chiefly due to its influence upon the nerves; the inhibitory fibres of the vagus being suppressed, the gastric mucous membrane becomes flushed with blood owing to vascular dilatation, the secretion of the gastric juice takes place with greater rapidity, and the peristaltic movements are accelerated; intestinal movement and secretion are likewise increased. But excessive and long-continued use of tobacco causes the gastric and intestinal secretions to be diminished and the peristaltic movements to be slower and feebler; it enfeebles the nerves of the ganglionic system, secretion and movement are slower, the mucous membrane of the mouth and throat gets dry, the throat inflamed, thirst becomes great, appetite fails, dyspepsia or gastric catarrh appears, and nutrition is impeded.

Nicotine is a cardio-vascular poison acting through the nerves upon the muscular tissue. The influence of excessive smoking on the heart consists of an increase of the excitability of that organ; the pulse becomes intermittent and irregular, periods of acceleration are followed by enfeeblement of its action. In some cases it causes abnormal quickening or tachycardia; in others, abnormal slowing or bradycardia. Functional derangements of the heart and digestive organs are common results, and organic changes sometimes occur in the nervous system, where it influences the circulation unfavourably and leads to degeneration and paralysis of nerve cells. One of the effects of chronic tobacco-poisoning is shown by anæmia of the brain, resulting in dizziness and vertigo on rising from a bed or chair, and enfeeblement of memory and power of concentration of thought. Further deleterious effects on nerve tissue are shown by general nervous debility; by tachycardia, as the result of paralysis of the vagus, or bradycardia, from degeneration or paralysis of the ganglia; by defects of vision, as amblyopia or amaurosis and paralysis of the portio dura, which are due to the exhibition of small doses of the poison frequently absorbed and acting over a lengthened period.

Much discussion has taken place as to what produces the harmful effects of smoking tobacco. Some writers assert that nicotine does not, and others that it does, exist in the smoke; that pyridine and other products of its decomposition during combustion produce the injury. Pontag gives the following composition of tobacco smoke: Hydrocyanic acid, 0·080 per cent.; pyridine, 0·146; nicotine, 1·165; ammonia, 0·360; carbon monoxide, 410 c.c. from 100 grammes of tobacco.[51] Thoms says tobacco smoke contains nicotine and its decomposition products, pyridine and its homologues, and a peculiar ethereal oil only produced during the combustion of the tobacco.[52] He states that this oil causes violent headache, trembling, and giddiness, and he attributes the toxic effects of tobacco to it, since it is known that they do not depend altogether on nicotine. The quantity of carbon monoxide is too small to have any effect on the health.[53] Brunton states that pyridine acts chiefly on the sensory nerves; that small doses stimulate, but large ones have a paralyzing effect on, the heart muscle.[54] **Nicotianine**, the so-called tobacco camphor, is a mixture of nicotine valerianate, camphorate, oxy-camphorate, and

pyridyl-carbonate; and nicotine-pyridyl-carbonate is the most highly toxic principle of tobacco, the other salts chiefly imparting fragrant characters to it.[55] The influence of the frequent inhalation of carbon monoxide upon the blood, which is ordinarily injurious, should not be overlooked; but Wahl[56] says it is so highly diluted that it may be breathed for four hours without ill results. Arsenic is known to exist in some kinds of tobacco, and being volatile can be detected in the smoke, and may have an injurious effect upon the smoker. Smoking a pipe is healthier than cigars or cigarettes; some of the carbon adheres to the pipe and forms a cake which absorbs a portion of the nicotine, and a plug of ashes and tobacco at the bottom of the bowl adds to the absorbent power. An oleaginous extract containing nicotine is deposited along the tube. The longer the pipe the less nicotine will there be in the smoke, and it has the advantage of being cooler and consequently less irritating to the mouth and throat. A hookah, with its bowl of rose-water through which the smoke is drawn, is as much superior to a pipe as the latter is to a cigar or cigarette. The pipe-smoker gets only half of the nicotine originally in the tobacco, while that in the smoke is only in contact with the mouth a short space of time. On the other hand, when smoking a cigar, the leaf is held constantly in the mouth, an infusion of tobacco is formed, and a considerable portion of the nicotine may be swallowed. In cigarette-smoking there is the additional temptation to inhale the smoke, which increases its injurious effects.

There can be no doubt whatever that the moderate consumption of tobacco, two or three pipes a day, is not injurious to the majority of smokers; that it acts as a powerful sedative, soothing the brain and assisting in the concentration of thought; that the after-dinner pipe aids digestion and the action of the bowels and kidneys; but it adds no potential strength to the body, is not a food, does not spare the tissues, and its action is destructive rather than constructive. In excess, its influence upon the digestive organs, heart, brain, and nerves, indicate its powerful deleterious effects. Very many people have no idea that tobacco is capable of producing ill effects; in others a habit of excessive smoking is formed which is most difficult to break. It is advisable never to form such a habit; in all cases the lightest and mildest tobaccos are the best, and a limit of 2 ounces per week is

a moderate allowance, beyond which it is not safe to indulge. The anti-smoker tells of cases of sudden heart failure, loss of memory, dwarfed growth, and early death attributed to smoking. Ardent smokers point to the hale and hearty old man who has smoked for fifty or sixty years, and attributes his health and longevity to it. Both have arguments in their favour; but the anti-smoker is prone to exaggerate, and the hearty old man does little justice to his sound constitution when he attributes his health and longevity to it. A well-known tobacco manufacturer says that tobacco is injurious in nine cases out of ten; but this he attributes to the large consumption of inferior kinds of tobacco, and he states that sufficient attention is not paid to the growth and blending of the leaf, to the soil on which it is grown, nor to the paper of which cigarettes are made. The best tobaccos are grown on virgin soil; the best cigarettes made with pure rice-paper. Many inferior tobaccos are used by mixing them with a better class of leaves; the colour is little to go by, as some leaves are blanched, others darkened by chemicals or colouring agents. *Tobacco Leaf*, which is a trade journal, says too much attention should not be paid to the outside of a *cigar;* a light-coloured cigar is not necessarily a mild one, nor a dark-coloured one a strong cigar; *avoid greasy or streaky leaves*, which contain an excess of nicotine, *and pale yellow* ones, which contain too little and are flavourless; unripe tobacco leaves are nauseous to the taste and have greenish blotches. Tobacco is neither better nor worse for being spotted. The ash should always be white or gray, never black or uneven. Good tobacco burns freely until it reaches the mid-rib or vein across a leaf, will never scorch or blister; it is an infallible *proof of a bad cigar*, made from inferior tobacco, if it shows a black rim or blister near the ash or if it goes out as soon as the light is withdrawn. Take off the outside cover of a cigar and apply a light to it; in a good cigar it will burn, but in a bad cigar made of inferior tobacco it will not take fire.

When one considers the enormous growth of the cigarette trade, and the almost incalculable number of cigarettes consumed annually, the consideration of their use becomes an important sanitary question. One has only to observe the pale face, the marble brow, the haggard and dwarfed appearance of boys who

indulge the habit freely to conclude that cigarette-smoking is decidedly injurious. This is, to some extent, due to the inferior tobacco from which so many of them are made; the commonest of tobaccos, frequently chemically treated and mingled with tobacco dust, are rolled in impure papers to make cheap cigarettes. The evil effects of cigarette-smoking are greatly enhanced by inhaling the smoke; that it really is inhaled is proved by the fact that very little smoke is exhaled. The fact that the smoke of a cigarette is not very irritating does not lessen the evil effect of drawing it into the lungs, for by this method the absorption of the poisonous principles is more rapid. Some absorption takes place in the mouth, but it is trifling in comparison with that which takes place in the lungs. It is admitted that moderate smoking allays restlessness and irritability and is slightly beneficial in other respects; but the sequel to the habit of inhalation may be very bad indeed, the heart and nerves bearing chiefly the effects of it. The fumes likewise appear to create an unnatural desire to be always smoking cigarettes, and those who indulge the habit generally consume more tobacco than they would by smoking a pipe, and the consumption is greater than is necessary for the ordinary enjoyment to be obtained from smoking. The habit should therefore be discountenanced by all medical men and others who have the interest of the human race at heart. Repressive measures are required to stop the practice of cigarette-smoking by children, for it is firmly believed that it prevents growth and renders its devotees a ready prey to disease. It not only makes them tired, lazy, and irritable, but it lowers their mental capacity and moral tone, makes them stupid, dull and weak, and prone to lying and cheating. Attempts are being made in America, Canada, Prince Edward's Island, and Norway, to suppress the habit by law; in some places it is a misdemeanour to sell or give cigarettes to a minor, and in others it is unlawful for a minor to smoke tobacco in any form.

ALCOHOL.

Alcohol is the principal product of vinous fermentation, and continues to be produced in a fermented liquid until the saccharine principles are exhausted, or the proportion of alcohol is such as to arrest further change.

Absolute alcohol, chemically known as ethyl alcohol (C_2H_6O), or ethyl hydroxide ($C_2H_5[OH]$), is a transparent, colourless, mobile liquid, specific gravity 0·795, of pleasant ethereal odour, very hygroscopic, mixing with water in all proportions. Pure alcohol burns with a white flame, but it is seldom bought quite pure; and if it contains any water it burns with a blue flame. It usually consists of 93 to 95 per cent. of alcohol and 5 to 7 of water, which is called pure spirit of wine. It evaporates without residue, is of neutral reaction, and presents no cloudy appearance when mixed with water.

Rectified spirit of wine of commerce contains 90 per cent. of alcohol, has a specific gravity of 0·825, is colourless, neutral, burns with a blue flame, evaporates without residue, and should be free from other kinds of alcohol. Spirits of wine containing 70 per cent. alcohol has a specific gravity of 0·880.

Proof-spirit or neutral spirit of commerce is alcohol and water in about equal proportions. It contains 49·3 per cent. by weight and 57·1 per cent. by volume of alcohol, and is defined by Act of Parliament as 'being such as shall weigh $\frac{12}{13}$ of an equal quantity of distilled water.' The terms 'proof,' 'under proof,' and 'over proof' are well known. Thus, 50 U.P. means 50 under proof, and is equal to 50 parts of water and 50 parts of proof-spirit; 60 U.P. means 60 parts of water and 40 of proof-spirit. On the other hand, 50 O.P., or over proof, means that 50 parts of water would be required to be added to 100 of the spirit to bring it down to proof strength. Spirits are regulated by *proof strength*; thus a publican or other salesman reducing the strength of whisky, brandy, or rum to more than 25 degrees under proof would be liable to a heavy fine under the provisions of the Sale of Food and Drugs Act, 1879.*

Alcohol, or ethyl alcohol, is produced by the fermentation of liquids containing sugar, starch, or glycerine, but under favourable conditions various higher alcohols (propyl, butyl, amyl,

* The percentage of alcohol in a liquid is determined by taking the specific gravity of the liquid at a known temperature. Thus, if a liquid at 15·5° be found to have specific gravity 0·8605, it will contain 75 per cent. by weight of alcohol. Tables are published which show these particulars, and are handy for use. Proof-spirit is taken as the standard. To determine the percentage of alcohol in wine, ale, etc., the liquid is *distilled* until one-third has passed over. The distillate contains all the alcohol, and when diluted to its original bulk with water it is tested for its specific gravity, and the alcohol is then determined from that.

hexyl, and heptyl alcohols), usually classed as fusel oil, are also produced. Many spirits derived from grain, oats, rye, barley, also contain **furfurol**. This is a volatile oil ($C_5H_4O_2$), soluble in alcohol, ether, and even water, having an odour somewhat resembling bitter almonds. It is colourless, but turns yellow or brownish on exposure to light,[57] and is held to be responsible for some of the ill effects of alcohol.[58] When solutions containing glucose ($C_6H_{12}O_6$) remain in contact with the air, they ferment, become turbid, and give off carbonic acid gas. After a time the whole of the sugar is tranformed into alcohol, glycerine, succinic acid, and the higher alcohols. Cane-sugar and milk-sugar also become fermented, but they must first be *inverted* or hydrolized. Every organism which has the power of assimilating cane-sugar produces an enzyme called **invertase**, by which the sugar is first inverted to glucose or dextrose and lævulose.[59] The substances used for the production of good spirits are malted and unmalted barley; but other grains are used, as rye, rice, and maize, and also potatoes, mangolds, beet-root and turnips. For ale and beer the saccharine substance is derived from malt, glucose, invert-sugar, caramel, etc.

Fermentation.—The formation of alcohol in saccharine liquids is due to the metabolic activity of the yeast plant, *Torula cerevisiæ* or *saccharomyces*, a low-formed organism belonging to the *fungi*. It grows naturally upon grapes and some other fruits, and is the principle in brewer's yeast which causes fermentation. The plant is of microscopic size, consisting of round or oval cells containing granular protoplasm, usually occurring together two by two, or in groups of five or seven. They are about $\frac{1}{100}$ millimetre in diameter. Their propagation under ordinary circumstances is by budding; but under certain conditions, as absence of sufficient food or a suitable nidus for growth, spores are formed, usually four in each cell. As the cell dries up the spores are liberated, and carried hither and thither by currents of air, to develop and propagate by budding when they alight upon material containing saccharine principles.[60]

The cells of yeast contain certain proteid substances, besides nuclein, leucin, tyrosin, cellulose, some hydrocarbon, and phosphates of soda, lime, potash, and magnesia. The high proportion of albuminoid constituents, phosphates, and other valuable salts,

has induced chemists to prepare from yeast certain foods of value in diabetes, scurvy, and other disorders.

The protoplasmic yeast cells multiply with enormous rapidity in all saccharine solutions of moderate temperature—68° to 86° F. The plant lives on the sugar, converts it to its own physiological uses, and during its metabolism produces mainly alcohol and carbonic acid gas with evolution of heat. It assimilates sugar in one form and excretes it in another. Cane-sugar, $C_6H_{12}O_6 =$ alcohol, $2C_2H_6O + 2CO_2$, carbonic acid. The cells contain a small proportion of the enzyme, **invertase**, by which cane-sugar or sucrose is converted into glucose before it becomes alcohol. Pasteur and Gay Lussac found that 100 parts of sugar become 105·26 of glucose, which in fermentation gives rise to alcohol, 51·11; CO_2, 49·31; succinic acid, 0·67; glycerine, 3·17; matter with ferments, 1·00 = 105·26. There is constantly produced a small quantity of ethers and alcohols of the higher series when complex matters are fermented; thus, when potatoes are fermented the distillate yields propyl, butyl, amyl, caproic, caprylic, and œnanthyl ethers and alcohols.[61] Alcohol is the primary cause of the well-known effects of fermented liquors, but secondary effects are due to the higher alcohols, ethers, essential oils, and non-volatile substances, for beer from which the alcohol has been driven by boiling has still a powerful effect upon the human economy.

The proportion of absolute alcohol in the principal liquors of commerce is as follows:

Whisky, gin, rum, and liqueurs contain ...	50 to 60 per cent.
Brandy, cherry brandy, etc. ...	About 36·5 per cent.
Port, sherry, and Madeira ...	16 to 22 per cent.
Champagne ...	10 to 13 ,,
Hock, Bordeaux, Burgundy, and claret	8 to 12 ,,
Cider and perry ...	5 to 9 ,,
Ale and porter ...	3 to 5 ,,
Koumiss and Leban ...	1 to 3 ,,
Herb beer of various kinds ...	1 to 3 ,,

The report of the Special Commission on Brandy in the *Lancet*, November 2, 1902, has the following:

Composition of Spirits.		Grain spirit.	Beet spirit.	Rum.	Whisky.	Gin.	Three-Star Brandy.
Alcohol, per litre	Weight ...	932·6	912·0	619·2	436·2	410·5	410·5
	Volume ...	956·0	942·0	695·0	512·0	475·0	485·0
Proof-spirit, per cent. ...		167·6	165·1	121·8	89·8	83·8	85·0
Extract, per litre		Nil.	Nil.	6·36	1·16	·52	6·70
Acids, as acetic		2·5	5·0	176·0	65·4	40·4	77·3
Aldehydes		0·1	11·5	22·1	28·0	9·9	12·6
Furfurol		Nil.	Nil.	2·9	3·9	0·3	1·7
Ethers, as ethyl acetate ...		3·6	18·6	443·1	75·6	18·6	110·0
Higher alcohols		2·9	7·3	93·9	239·7	27·9	12·0
Total secondary products*		9·1	42·4	738·0	412·6	97·0	322·2

General Remarks on the Effects of Alcohol.—When considered as a food, alcohol is classed with the **hydrocarbons**. It was formerly believed that none of it was utilized in the animal economy. It is now known that a portion is consumed, and that by its oxidation it yields heat and energy, and thereby saves the tissues of the body from being consumed to the same extent, just like the oxidation of sugar, starch, or albumin.[62] A gramme of alcohol during oxidation yields seven calories or units of heat. It must, however, be confessed that alcohol is not a necessary article of food—that it is a luxury. Indeed, it has been proved again and again that the fullest mental and physical work is better obtained without it, that men can bear fatigue and extremes of climate better without than with it, and trainers have long recognised the fact that the power to sustain prolonged exertion and resist fatigue is fullest when alcohol is abstained from.

The action of alcohol in any form is similar. Ale, wine, and other liquors, by virtue of their taste, flavour, and the aromatics or tonics they contain, give a relish to food and increase appetite and the flow of saliva and gastric juice. When a person is fatigued and loses appetite, therefore, a glass of wine or beer will rouse the sense of taste, restore appetite, provoke a flow of saliva and gastric juice, and to that extent assist digestion. At the same time the heart is stimulated, the skin is flushed and warmed, and a feeling of increased power and vigour occurs. As an appetizer and invigorator its *moderate* use is of value for persons who are weak, convalescent, aged, for those who lead

* The secondary products are reckoned in grammes per litre.

a sedentary life, or whose stomach has lost its tone owing to mental anxiety, worry, overwork, town life, and similar conditions. *Larger doses* hinder digestion until the alcohol is absorbed, and are likely to upset the stomach and cause indigestion or catarrh. Experiments have shown that the ultimate result as regards digestion is no better than if none had been taken.[63] Blumeneau[64] tested the action of alcohol in healthy stomachs, with the following results: Alcohol diminishes or hinders stomach digestion during the first three hours, owing to the presence of lactic acid, the secretion of which is excited by it instead of hydrochloric acid; strong forms of alcohol hinder more than weak ones; the motor activity and absorptive power of the stomach are diminished in proportion to the strength of the alcoholic liquid; it renders the secretion of gastric juice more abundant and prolonged; and during the fifth and sixth hours after the meal hydrochloric acid is rapidly formed and food quickly digested.

With regard to work, alcohol is oxidized in the system and gives off heat and energy like fat and carbohydrate. But its influence is not so good as is generally imagined by those who rely upon it as a source of energy. Indeed, it has been proved by experiments that, although there is a temporary increase of power, the ultimate effect is a decrease of muscular power. Scheffer[65] has shown that alcohol first increases and then diminishes the power of doing muscular work, and that muscular irritability passes through the same phases; that if the peripheral motor nerve apparatus is first eliminated by curare, alcohol has no effect whatever. The effect of a moderate use of alcohol on the nervous system is to enliven the mind by causing a free circulation of blood through the brain. It excites the imagination, gives an increased feeling of importance and happiness, and makes the person talkative; the spirits are raised, wit is sharpened, conversation improved. It does not always produce a light, gay, ideal hilarity, but it may cause a tumultuous, noisy, clamorous merriment; and in some people it confuses the mind, irritates them, and makes them angry and quarrelsome. The first effect of alcohol on the nervous system is *stimulation*, but *the secondary effect is depression*, like that of all narcotics. If the dose has been a large one—and in many cases a small dose

is an overdose—the phenomena of stimulation are succeeded by those of depression; the mind becomes dull, the intellect blunted or paralyzed, and the muscles unsteady or staggering. Then follow still further loss of the power of balancing and co-ordination, inability to walk, sit, or stand, attended by drowsiness or coma, and possibly failure of the heart or paralysis of the cardiac and respiratory centres, which may end in death. Ringer[66] classes alcohol with ether and chloroform: they first produce excitement with increased strength of the pulse, which after a time gives way to more or less profound unconsciousness. With chloroform and ether the excitement soon passes into insensibility, which may last a long time without danger to life. With alcohol, on the contrary, the stage of excitement and intoxication is of long duration, but when the stage of insensibility and unconsciousness is reached, there is danger of death from paralysis of the heart and respiration.

The Habitual Use of Alcohol.—In strictly moderate doses it has not been proved that drinking it does any harm; but that dose is varied in individuals by idiosyncrasy and many circumstances. The amount which is absolutely harmless to one may be very injurious to another person. It has been proved by experiment that the daily dose which the body can dispose of by complete oxidation into carbonic acid and water is equivalent to 1 ounce or $1\frac{1}{2}$ ounces of absolute alcohol. Alcohol enters the blood unchanged, or partly as aldehyde, and is distributed through all the tissues and organs, a small part being transformed into acetic ether or acid and carbonic acid. The primary physiological effect of alcohol is to lessen the destruction of the tissues by being itself oxidized; this is proved by the diminution which takes place in the excretion of urea by the kidneys and carbonic acid by the lungs when it is taken; about 3 per cent. may be eliminated unchanged by the skin, lungs, and kidneys, and the rest, above the amount previously stated, lies in the tissues of the body and undergoes very gradual transformation and elimination.

Long-continued use of alcohol produces degenerative changes in the system; first in the stomach and liver, later in the kidneys lungs, bloodvessels, and brain. The change consists mainly in an increase of the fibrous-tissue elements. Such increase of fibrous tissue, by its ultimate contraction, causes atrophy of the glandular

structures and loss of their function. Chronic catarrh and cirrhosis of the stomach, and hyperæmia and cirrhosis of the liver, are well-known effects of alcohol, and often result in dropsy and hæmorrhage. Bright's disease, too, is a frequent result. Speaking of its effects on the stomach, Ringer says: Excess of alcohol excites chronic catarrh of the stomach, the mucosa becomes chronically inflamed, tenacious mucus adheres to it, and the structure of the membrane is altered; there is a great increase of the interstitial fibrous tissue, which, by its growth and contraction, obstructs and destroys the secreting follicles and cells, the mucous lining becomes thickened, hard, and uneven, the follicles obliterated, and very little gastric juice is poured out in response to the demands made by the food; consequently, unhealthy fermentation is excited, various acids, such as butyric and acetic, are formed, and much gas is developed, with the corresponding symptoms of heartburn, acidity, flatulence, and morning vomiting of a scanty, sour, tenacious fluid, which is characteristic.

The effects of 'tippling' on the bloodvessels is precisely the same as the changes due to old age, an increase of fibrous tissue and degenerative changes being brought about, with consequent depreciation of brain power and a tendency to cerebral hæmorrhages with paralysis. The action of alcohol on the nervous system is, firstly, to paralyze the vaso-motor nerves and congest the parts with blood. If this is continued or is increased, the congestion becomes greater, and alcohol, parting from the nutritive fluids (blood and lymph), acts as a poison upon the nervous tissues.[67] The deleterious effects of alcohol upon such delicate tissues has been shown by examination of the brains of many sufferers from chronic alcoholism, delirium tremens, neuritis, epilepsy, anæsthesia, irregular paralyses, and various forms of insanity. Witness also the many cases of mental degeneration, exhibited in the form of loss of memory, of power of thought and concentration, the wreck of business capability, and the moral effects of inebriety, which are too well known to need dilating upon. Not only does the alcohol itself produce these dire effects, but the higher alcohols and furfurol are largely held responsible for them. Fusel oil, as these substances are called, is largely present in immature spirits, in whisky, grain spirits, and in liqueurs such as absinthe, vermouth, etc. Furfurol is very

poisonous, and causes tetanic or epileptic convulsions in animals, whilst the respiratory movements are slackened and soon completely arrested. Brouardel[68] considers that this throws much light on alcoholism, and that it may explain the attacks of epilepsy which sometimes occur.

It has recently been pointed out by Mr. Pearce Gould that in certain army regiments 92 per 1,000 of the non-abstaining men were admitted to hospital, as against only 49 per 1,000 among the abstainers. The effect of intemperance in shortening life is universally known. Statistics have shown this so clearly that it may be stated generally that the mortality of the intemperate is four or five times greater than the mortality of strictly temperate persons of the same age and position in life; indeed, so far has this been recognised by insurance companies that they all charge a higher rate of insurance upon the lives of known inebriates, while some offices give a decided advantage to abstainers. The mortality of publicans, innkeepers, wine and spirit dealers, is 50 per cent. higher than that of all other people at the same age, and the death-rate amongst them from nervous, liver, kidney, and other diseases, is more than double.

Specific Uses of Alcohol.—It may be employed in fevers and other wasting diseases, where, by its oxidation, it acts as a food, spares the destruction of the bodily tissues, reduces the temperature, and stimulates the heart and circulation; a dry brown tongue, restlessness, and a feeble, irregular pulse, are the indications of its necessity. It is best given in the form of brandy or strong wine in a definite quantity, according to the condition of the pulse and heart, the general strength, the height of the fever, the ability to take nourishment, and the age and previous habits of the patient. *It is not required in every case of fever*, and many cases have been aggravated by its unwise, injudicious, and excessive use. Especially is this so in the first stage of fevers and inflammation, when, congestion already existing, alcohol can only increase or aggravate the previous condition. It should not, therefore, be given as a rule in the febrile stage of diseases. Armstrong and Greaves formulated these aphorisms about the effects of alcohol: (1) *It is doing good* if the tongue becomes moist, the pulse slower, the breathing more and more tranquil, and the skin moist. (2) *It is doing harm* if the

tongue becomes dry and brown, the pulse quicker, the breathing increased in frequency, and the skin hot and parched. Young children and aged persons usually bear stimulants well, and it is often necessary to administer them early to these, to prevent the prostration of their already enfeebled powers.

After the inflammatory or febrile stage of a disease has passed off, there succeeds a depression of the pulse and temperature, with anæmia and other indications of greatly enfeebled bodily powers, when the skilful use of stimulants may prevent a patient from dying or hasten his convalescence. But the proper use of alcoholic stimulants is a temporary one, and the patient should be impressed with this fact.

In chronic diseases of the heart, when the natural compensatory hypertrophy fails and dilatation ensues, a good wine or spirit is valuable. When death is threatened through cardiac failure from shock, hæmorrhage, or syncope, spirits are the best, and are usually available and convenient. They are rapid in their action and almost invariably successful, and may be given by the stomach, bowel, or under the skin.[69]

In mental or nervous cases alcohol should be ordered with the greatest hesitation ; it affords too ready relief from the effects of grief, anxiety, suspense, or overwork, neuralgia, insomnia, hysteria, and such speedy relief may very soon lead to its abuse. The best thing is only to recommend weak alcoholic drinks, if any at all, in these cases, as ale, stout, or claret, *to be taken at meal-times only ;* even these are not always safe, because the habit of intemperance is quickly formed by such persons.

In convalescence, alcohol in one form or another has a favourable influence upon the nutrition, the manufacture of blood is encouraged by it, and a general restorative effect is observed in anæmia, atony of the digestive organs, general debility and lowering of the system. In the paragraphs on various forms of alcohol, the cases most benefited by each kind are mentioned, where any special influence has been observed.

Brandy.—Brandy is the spirit distilled from wine made from the juice of grapes. Inferior brandy is sometimes made from the refuse of grapes after the juice has been expressed, and it is made up by admixture with various materials. English brandy is usually artificial ; a common mode of manufacture is to soak

bruised prunes and argol in proof-spirit and distil it, afterwards adding about 25 per cent. of good brandy and flavouring with ethers and tannin.[70]

Brandy is distilled wherever wine is made from grapes, as in France, Portugal, Spain, and California; but long observation has proved that the grapes of certain districts yield brandy which cannot be equalled for bouquet and agreeable qualities, such as the cognac of France.

Maturing.—Grape spirit or brandy retains the characteristics of fermented grape juice, but *time* produces characters in it which are equally important with those due to the kind of soil and climate which produces the vine. Brandy is matured by keeping it under proper conditions; that is to say, it develops the taste and aroma of fine brandy, which is chiefly due to the conversion of the higher alcohols into a group of **esters** or ethereal products, such as acetic, œnanthic, butyric, and valeric ethers, and other aromatic bodies. A well-matured spirit is soft and agreeable to the palate, but contains no sugar or sweetening agent, its sweetness being due to the normal products of maturation. It should be free from crude alcohols of the higher series, which destroy the value of cheap spirits for therapeutic purposes.

The secondary products obtained by Ordonneau from 100 litres of cognac were — higher alcohols = propyl 40 grammes, butyl 218, amyl 83·8, hexyl 0·6, heptyl 1·5, besides ethyl acetate 35 grammes, œnanthic ether 4, ethyl proprionate, butyrate, and caproate 3, aldehyde 3, and traces of acetyl and amines.[71] Brandy contains as much as 50 to 55 per cent. of alcohol, but it may have only 35 per cent. or less. The *Lancet* gives the following analysis of a specimen of invalid cognac: Alcohol by weight, 38·22 per cent. (by volume 45·41, equal to proof-spirit 79·5); acidity, reckoned as acetic acid, 0·039; extractives, 0·725; mineral, 0·005; and volatile ethers equal to 2·02 parts of alcohol in 10,000. In addition to alcohol and ethers, brandy usually contains a little tannin, acetic and other acids, sometimes a little grape-sugar and colouring matter. The tannin, methylic and amylic alcohols, may be in excess, and consequently injurious; and it has been found to contain copper, lead or zinc from being stored in metallic vessels, and cayenne or other hot materials have been added.[72]

Brandy is the best form of spirit to use in most cases of acute

illness, especially where it has to be given in regular and definite amount every hour or two ; it is also the best for spasms affecting the heart or stomach and bowels, faintness, syncope, and many other ailments in which a spirituous liquor is valuable. It may be given in plain water, soda-water, milk, or any other liquid ; a good form for administration is the brandy mixture of the British Pharmacopœia, or the following : Let an egg be beaten up, pour upon it half a teacupful of boiling milk, add a little sugar, one or two tablespoonfuls of brandy, and mix it. In a bad case of pneumonia or similar disease, a tablespoonful of brandy every three hours is a sufficient quantity.

Whisky.—Whisky is properly made by distillation from malted barley ; but it is sometimes produced from Indian corn, rye, potatoes, molasses, and various other substances. Scotch whisky of good quality is made from malted barley alone, Irish from malted and raw barley together, but other differences exist in their manufacture. 'The highlands of Scotland and Ireland are equally celebrated for its manufacture, the finest quality of barley being made into malt with water from heather-clad hills, and dried in kilns with fires made of peat supplied in the neighbourhood.' The old-fashioned *pot-still* is said to produce the finest whisky, but Coffey's patent still is largely employed. Good whisky contains 380 parts in 100,000 of secondary products ; but they are only produced by the pot-still to this extent, for *patent-still* whisky never contains more than 240 parts of secondary products in 100,000. Good whisky cannot be made from grain, rye, maize, beet, mangold, potato, etc., but only from malted barley, or from this with a small proportion of unmalted barley. The secondary products, commonly called **fusel oil**, consist chiefly of the higher alcohols. Propyl alcohol is almost a constant constituent ; butyl alcohol is also largely present ; iso-butyl alcohol occurs when mangolds are used ; and iso-amyl alcohol is the principal constituent of fusel oil when the spirit is derived from potatoes. Hexyl and heptyl alcohols are also present. The following is the percentage composition of fusel oil[73].

	Clandon and Morin.	Ordonneau.
Propyl alcohol	11·9	11·7
Normal butyl alcohol	49·3	63·8
Iso-butyl alcohol	4·5	0·0
Amyl alcohol	24·4	24·5

Good malt whisky should be mild and smooth to the taste, have the flavour of malt and peat smoke, and be free from the undesirable higher alcohols and by-products. It may contain 35 to 60 per cent. of alcohol. The *Lancet* gives the following proportions in a special brand of Scotch whisky[74]: Alcohol by weight 39·30 per cent., by volume 46·5, equal to proof-spirit 81·64; volatile acids 0·024, minerals 0·015, extractives 0·840. **Irish whisky** has alcohol by weight 40·8 per cent., by volume 48·4. The *adulterations* of whisky are wood-spirit, creasote, fixed acid, and potato spirit or **fusel oil.**

Maturing.—Whisky should never be drunk new or raw, because it contains a varying proportion of amylic alcohol or fusel oil derived from the starch, which is always in largest proportion where potatoes are used in the manufacture. Fusel oil is very injurious, and speedily poisons small animals; its effect on man is to produce rapid intoxication, with headache, depression, general nervous indisposition, and other evidences of its deleterious action on the body. The careful treatment of the malt is responsible to a large extent for the quality and flavour of the spirit, but neither the material nor the kind of still used are such potent factors in producing a wholesome fluid as maturing it by age. All new whisky is vile and unpalatable, and time alone can bring about the changes requisite in it by the conversion of the higher alcohols into esters or ethereal products. Many efforts have been made to produce artificially the effects of *maturation*, but the natural organic changes have baffled all attempts at imitation. Some spirits mature earlier than others, but the minimum time allowed should be five years; not less important is it to buy only those spirits which have been made by distillers who guarantee its production from malt alone.

Whisky is said to be the best form of alcohol for invalids with diseases of the chest attended by difficulty of breathing, but it is also useful in the many circumstances for which brandy is recommended when the latter is unattainable.

Rum.—The finest rum is produced by distillation of the fermented molasses of cane-sugar, and inferior qualities from the débris of the sugar-cane or beet-root molasses. As the best malt whisky is produced in Scotland and Ireland, so the finest rum is produced in Jamaica; nothing exactly replaces the cane-sugar of

the West Indies for its manufacture. Its strength varies from 50 to 90 per cent. of alcohol, and it is matured by age.

Gin.—Gin is distilled from rye and various flavouring substances; good examples contain 80 to 85 per cent. of proof-spirit, with 5 or 6 per cent. of flavouring material and some sugar; it is usually sold at 25 to 35 degrees under proof.

Gin is stomachic, stimulant, aromatic, antispasmodic, and diuretic. It has therefore a wide range of application; but very great care is required in prescribing it, because of the rapid formation of habits of intemperance. The properties of gin are mainly due to the following or other substances used in its manufacture:

The berries of *Juniperus communis* (N. O. Coniferæ) contain 0·5 to 0·75 per cent. of an oil having a bitter taste and characteristic aromatic odour. It is a specific stimulant to the cells of the kidneys; it increases the secretion of water and the materials contained in it, and gives to the urine an odour of violets. This ingredient, by its diuretic property, makes gin of value in dropsy due to liver and heart diseases, and in some cases of Bright's disease. In large doses, however, juniper will cause inflammation of the kidneys and strangury, and is decidedly injurious in Bright's disease.

Cardamom and coriander seeds are likewise used; they contain a pale yellow oil having antispasmodic and carminative properties.

Calamus root, angelica root, grains of paradise, and cassia, all containing essential oils and active principles, are used in making gin, and contribute to the carminative, aromatic, and intoxicant effects of that liquid.

Absinthe.—This is a spirituous liquor of greenish-yellow colour, containing the essential oil of numerous aromatic and antispasmodic bodies, such as wormwood, or *Artemisia absinthium*, angelica, parsley, cloves, cinnamon; and the colour is due to the chlorophyll from wormwood, hyssop, veronica, spinach, nettles, and parsley. Hubert[75] found it to contain 50 to 70 per cent. of alcohol, acidity 0·09 to 0·28, aldehydes 0·025 to 0·15, furfurol 0·0002 to ·0004, esters 0·071 to 0·123, essential oils 2·614 to 4·25. The colour of absinthe should be due entirely to the herbs named above and not to artificial colours. Wormwood contains **absinthin,**

a bitter substance, and **absinthol**, a terpene, which is the essential principle. Essential oils are also derived from the other substances which are used in its manufacture.

Alcohol produces its customary effects when absinthe is taken, besides which particular effects are produced by the bitters and essential oils contained in it. The primary effect is one of exaltation to the nervous system, a quickening of the circulation, and increase of appetite and digestion ; but it is followed by a depression which may be very profound. When taken habitually or to excess, the essential oils, especially the absinthol, have a very deleterious effect on the nervous system ; headache, giddiness, hallucinations, and loss of memory, with subsequent degeneration of the mental and moral faculties, ultimately render the absinthe-drinker a very depraved creature. Absinthe-poisoning or drunkenness is attended by sudden and severe headache and giddiness, delirium in which hallucinations affecting all the special senses occur, epileptiform seizures, loss of consciousness, and, on recovery, loss of memory and a tendency to manifestations of hysteria.[76 77]

Liqueurs or Cordials usually contain about 40 or 50 per cent. of alcohol, and, like absinthe, are flavoured with numerous things containing essential oils ; for example, curaçoa, benedictine, vermouth, and many others. Their colouring is due to simple substances like chlorophyll, cochineal, or turmeric ; but more harmful materials have been used, as picric acid and aniline dyes.[78] The custom of taking bitter appetizers—*e.g.*, 'gin and bitters'—before the heavy meals of the day, or similar liqueurs at the end, with the object of stimulating appetite and digestion, is very widespread. Experiments have proved that **bitters** render the sense of taste and enjoyment of food more acute, and temporarily increase the gastric secretion; but the habit is susceptible of abuse when the vehicle is an alcoholic liqueur. It may be observed that a small quantity of an alkali taken in place of them exercises an equally favourable influence on the secretion of the stomach, and that a few tablespoonfuls of soup at the beginning or a small piece of cheese at the end of the meal subserve the same purpose.

Arrach and other Spirits.—**Arrach** is a spirit obtained by the distillation of fermented rice liquor or the juice of the palm or cocoanut tree ; it contains about 50 per cent. of alcohol, and is some-

times drugged with Indian hemp or other narcotics.[79] **Doasta** is the name of a spirit distilled from rice liquor and sold in Calcutta; Mann found it to be about 20 degrees under proof, but it contained higher alcohols amounting to 0·561 per cent., or 491 grains per gallon. **Shajehanjur rum** made from sugar refuse is 53 to 56 degrees under proof. **Mahua spirit** is made from the flowers of *Bassia latifolia* in Bengal and Assam. The flowers contain 58 per cent. of fermentable sugar. The spirit is from 22 to 60 degrees under proof, and contains 0·04 to 0·33 per cent. of higher alcohols or fusel oil, which is an enormous amount, and must be very prejudicial to the health of the consumer.[80] In Japan the spirit distilled from rice is called sochu; in China spirit distilled from rice or millet is called sautchu; in Thibet a similar spirit is arra. We have seen that arrach is distilled from various kinds of grain; the flowers of the mnowha-tree and of various palm-trees are also used in India. In Tartary, koumiss yields a spirit called arika; in the Caucasus, kephir, a similar fermented drink, yields a spirit called skhou; in Peru, a spirit called puichui is derived from manioc and maize; and in Mexico, a spirit called octli is derived by distillation of pulque, the fermented juice of agave.[81] The juice of the *Agave Americana* is rich in sugar; Bassingault gives the following composition: 1,000 parts of the juice contain 26·45 parts of lævulose, 61·71 of saccharose, 3·53 of malic acid, 5·45 of gum, 10·13 of albumin, and 6·2 of salts.

WINE.—Wine is the fermented juice of the grape, and is the most important of all fermented liquors. Its action is modified to some extent by other substances derived from the fruit. Natural wines are here alluded to, and not the concoctions sometimes sold under that name. A good wine is a splendid union of principles calculated to arouse the nutritive functions and invigorate the body, without unduly exciting the nervous system. Besides alcohol, it contains several parts of grape-sugar, and various albuminoid bodies; succinic acid, glycerine, mannite, gum, and fatty matters; mineral salts, chiefly potassium in the form of cream of tartar, sulphates, carbonates, phosphates and chlorides of magnesia, soda, lime, and iron; organic salts as tartrates, citrates, acetates, malates, racemates, butyrates, and proprionates; free acids, such as carbonic, acetic, tartaric, and other organic acids; colouring matter and tannin; and the

bouquet resulting from the union of several odoriferous matters similar to perfumes, as aldehyde and higher alcohols and ethers, including caproic, caprylic, acetic, malic, butyric, and pelargonic.[82] Numerous as the above list appears, it is not complete, and they may not be all present in a given sample of wine; sometimes one or other may be in excess of the average. The organic salts are valuable constituents, and become oxidized in their passage through the body into alkaline carbonates; but an excess of organic acid gives rise to a marked acid reaction, and is just that property in wine which may cause acidity of the stomach, water-brash, and other signs of indigestion or gout.

What are known as **light wines**, among which we may include Burgundy, Bordeaux, hock, chablis, cahors, Moselle, sillery, and champagne, contain from 5 to 15 per cent. of alcohol; the heavier or stronger wines, as port, Madeira, sherry, contain from 15 to 25 per cent.

PERCENTAGE OF CONSTITUENTS IN WINE.

	Alcohol.			Extractives.	Mineral Matters.	Sugar.	Free or Volatile Acids reckoned as Acetic.	Fixed Acid reckoned as Tartaric.	Phosphoric Acid.
	By Weight.	By Volume.	Equal to Proof-Spirit.						
Burgundy and Bordeaux ...	10·85 to 12·38	13·43 to 15·30	23·54 to 26·83	2·28 to 2·71	0·24 to 0·27	0·14 to 0·21	0·096 to 0·108	0·22 to 0·307	—
Pommard ...	12·38	15·3	26·83	2·74	0·20	0·23	0·102	0·262	—
Beaune ...	11·62	14·37	25·18	2·90	0·25	0·30	0·102	0·307	—
Chablis (white)	10·87	13·43	23·54	2·62	0·26	1·20	0·084	0·420	—
Moselle (white)	8·64	10·73	18·81	2·14	0·18	0·25	0·070	0·670	0·924
Port	17·05	21·19	37·13	9·20	0·22	7·56	0·071	0·340	0·029
Hungarian (red)	8·29	10·30	18·04	2·34	0·24	0·23	0·140	0·530	0·035
Australian ...	13·15	16·24	28·46	3·52	0·32	0·36	0·240	0·440	
Champagne ...	12·38	15·30	26·82	3·67	0·11	1·92	0·090	0·600	

The list given above is collected from the *Lancet* analyses of special samples of natural wines recommended by merchants for invalids and others. Wine bought at a fair price from a respectable merchant is usually a genuine article, but low-priced wines

are sometimes of extremely bad quality, and may be entirely artificial. Port is often fortified with brandy and artificially coloured, or mixed with inferior wines; cream of tartar and various ethers may be added to give an appearance of age and flavour; it is often plastered with gypsum and the brilliance increased by alum; sherry, claret, champagne, and other wines, are frequently plastered and fortified by spirits and otherwise 'faked.' Many colouring matters are used in this process, as fuchsine, Brazil-wood, logwood, cochineal, fresh beet-root, hollyhock, and elder-, whortle-, privet-, or portugal-berries.[83]

Artificial colouring may be detected thus: Dissolve a piece of caustic potash in the liquid; if the wine is natural it assumes a greenish shade of colour, but gives no deposit. The formation of a deposit indicates artificial colouring; if it is violet, the colouring may be due to mulberries or elderberries, which are not injurious; a red deposit indicates the presence of beet-root or Brazil-wood; red-violet, logwood; blue-violet, privet berries; pale violet, litmus.[84] Fuchsine is detected thus: Add a little acetate of lead and amylic alcohol to the wine, shake it briskly, pour it into a glass, and allow it to stand. The amylic alcohol will soon separate and be coloured red by fuchsine; if it is not so coloured, fuchsine is absent.[85]

Many *home-made wines*, or wines made from fruit other than grapes, are excellent and very wholesome; they have not such a fine bouquet as sherry, port, or claret, but they contain from 10 to 15 or more per cent. of alcohol, with organic salts, etc.; currant, rhubarb, gooseberry, and elderberry wines, cider, perry, mead, and pulque, are all excellent in their way, and contain the properties and qualities of the material from which they are made.

When wine is kept too long in cask or bottle there is a deposition of tannin and colouring matter, and some of the sugar disappears; when air is not absolutely excluded, acetous fermentation takes place from the presence of a microbe, *Bacterium aceti*. which transforms alcohol by oxidation into acetic acid[86]—C_2H_6O becomes $C_2H_4O_2$; consequently the wine is sour, and the presence of acetic acid increases any other properties which the wine has of causing dyspeptic and gouty symptoms. Other species of fermentation may also take place in the liquid; thus a bacterium

converts sugar into lactic acid and increases the acidity of the wine, and the butyric ferment attacks fatty or oily substances and produces butyric acid. There is a risk of lead-poisoning through the storing of acid wine in earthenware vessels glazed in the usual manner with litharge; lead is readily dissolved in cider, perry, or any wine which has become sour; if earthenware vessels are used for such a purpose, they should be glazed with a hard salt glaze. These facts indicate the extreme care which is required in storing and preserving wine, so as to develop therein the good qualities of such a fluid and check the production of bad ones.

In considering the influence of wine upon nutrition, and its effects upon the individual in various diseases, its constituents must be taken into account. Wine, having a specific gravity nearly that of water, is absorbed less readily than spirit, which is a favourable circumstance, as it spreads the absorption over a longer period, and renders wine less dangerous than spirits. Wine is absorbed without change; its bouquet and aroma stimulate taste and appetite and influence nutrition favourably; the aromatic constituents stimulate the glands of the abdomen and favour the manufacture of blood cells; the general constitution of wine has a restorative action on those exhausted by fatigue, mental labour, insufficient food, or long illness, and in various diseases, as anæmia, atony of the digestive organs, general debility, and low states of the system.

There are good and bad years for wine-making, the vintage having very much to do with the quality of the finished product. As examples, good **Burgundy** was produced in the following years: 1874, 1877, 1881, 1883, 1885, 1886, 1887, 1889, 1890, 1891, 1892, 1893, 1894, 1896, 1898, and 1899; and good **Bordeaux** in the years 1871, 1874, 1875, 1877, 1880, 1887, 1888, 1889, 1890, 1891, 1893, 1898, 1899, and 1900; good **port** in 1851, 1852, 1853, 1858, 1862, 1863, 1867, 1868, 1872, 1873, 1875, 1884, 1887, etc. Little can be said of the general characters of particular wines here; a few remarks will suffice: **Hock**, still or sparkling, is light and easily assimilated. **Sherry** contains more alcohol, but good varieties, Amontillado, Manzanilla, Olerosa, are wholesome, light, and delicate. **Port** is very much heavier, contains a larger proportion of alcohol, sugar, and other bodies, but

it is a rich and fruity wine, and when old and tawny has a delicate and soft flavour and bouquet ; it has been credited with having caused many attacks of gout, but it should be remembered that port is not the only stimulant capable of awakening a slumbering enemy. **Madeira** is of great softness and elegance, and has a beautiful bouquet ; formerly it was not considered to be properly matured until it had made several long sea-voyages, but a few years storage under proper conditions are sufficient for its maturation. Good **claret** is the natural wine of the Bordeaux and Burgundy districts ; it is not injurious, but usually wholesome. Burgundy often has sugar added to it, which renders it heating, less pleasant to the palate, and destroys the true flavour of the wine. **Chablis** is a white Burgundy of soft, light, and nice flavour ; **beaujolais** is also a light and delicate wine of full flavour, and such also is **pommard** ; **beaune** is pleasant, light, and well flavoured ; and **chambertin**, when well matured, is fine and mellow. **Moselle**, still or sparkling, is the favourite table wine of Germany, and is especially recommended for persons suffering from stone, rheumatism, and all diseases of defective metabolism ; it is wholesome, light and agreeable, free from acidity, and easily digested. **Malaga** contains 11 to 15 per cent. of alcohol, and 14 to 23 of extracts ; **Teneriffe** wine 15 to 18 per cent. of alcohol, and 4 to 7 of extracts. **Tokay** contains a larger proportion of phosphoric acid than any other wine, and when good may be prescribed medicinally as a tonic. Hungarian, Italian, Swiss, Californian, and Australian wines are useful tonics, especially the ferruginous wines like ophir and tintara. Absolutely **dry champagne**, without added sugar, is recommended for invalids suffering from gout, rheumatism, indigestion, and other diseases where saccharine or highly alcoholic wines are prohibited. Rheims is the champagne centre of France, where its manufacture is a speciality. The juice of black grapes only is used, the skins being rejected because the tannin and colouring matters are not wanted. The *must* or liquor is stored in rock cellars, where it ferments and deposits lees, and is poured from one cask to another until it is clear and bright. The products of different vineyards are blended after fermentation ; the proportion of sugar is then ascertained, and any deficiency made up by the addition of sugar-candy, for a definite proportion of sugar is required to

produce the future sparkle. It is now bottled and stored in a warmer atmosphere until the effervescing character begins to appear, after which it is transferred to cellars for three or four years to mature. During maturation a deposit is formed, and the bottles are placed so that it settles upon the cork; when mature the cork is removed with the deposit upon it; liqueur is now in some cases added, and a fresh cork put in. **Vin brut** is the natural champagne, having no added liqueur; it is the best dinner beverage, and assists appetite and stimulates the circulation. Good champagne should be fairly free from sugar and acidity, and is not then injurious to gouty and rheumatic patients in a greater degree than other light wines. It is sometimes serviceable in cases of acute illness where there is a tendency to heart failure, in obstinate vomiting and convalescence.

MALT LIQUORS.—Malt is a grain in which germination has been encouraged by warmth and moisture to a certain point, and then stopped by heat. During the process a ferment or enzyme is produced which transforms some of the starch of the grain into sugar. **Barley**, which is the grain usually malted, contains starch, albumin, dextrin, a little fat, cellulose, and mineral matter. **Malt** differs from it in containing more sugar and dextrin, less starch and organic material. Thus **dried barley** contains: Starch, 65·7 per cent.; sugar, 5·5; albuminoids, 11·8; fat, 2·5; cellulose, 9·5; ash, 3·1 (*Oudemann*). **Pale malt** contains: Starch, 44·15 per cent.; sugar, 21·23; fat, 1·65; albuminoid, 13·9; cellulose, 11·57; ash, 2·60 (*Valentine*).[87]

In the process of malting, the grain is *steeped* in water for twenty-four to forty-eight hours, during which it swells by absorption of 10 to 30 per cent. of water, and begins to germinate. It is then *couched* or piled in heaps upon a stone floor, by which heat is generated in the mass and germination thereby encouraged. It is afterwards *spread* on floors and stirred frequently to expose it to the air, the growth of the acrospires, or rudimentary stems, being here carried to the desired limit, which is known by their length and appearance. It is then *dried* in a kiln at 50° to 100° F., and the young sprouts are broken off by handling and removed by sifting; the finished malt is pale or dark brown, according to the degree of heat used in drying it. During the process of malting the following changes

take place : Some of the gluten breaks up into vegetable gelatine, which gives body to the malt liquors ; another portion of albumin is transformed into the enzyme **diastase**, and the diastase converts about one-third of the starch into sugar, or maltose and dextrin. Colour is imparted to the malt, and an empyreumatic oil which gives flavour is generated by drying. The changes make *malting* of the grain advantageous to the brewer and distiller ; they are unobtainable by any other means, and care is required in the process to insure the proper development of these properties. Various substitutes are frequently used for malt in the manufacture of malt liquors—*e.g.*, glucose, invert-sugar, caramel, etc.[88]

The ordinary malt liquors are ale, stout, porter, lager beer, and bock. **Pale ale** is made from the finest and highest dried malt and the choicest hops, and is bitter ; it contains about 14 or 15 per cent. of extract of malt and 6 or 7 of alcohol. **Scotch ale** contains about 10 per cent. of malt extract and 8 or 9 of alcohol. **Lager beer** usually has 9 or 10 per cent. of malt extract and 4 or 5 of alcohol. **Bavarian beer** is fermented at a low temperature, has only 2 or 3 per cent. of alcohol, is rather bitter, of fine aroma, and a peculiar flavour derived from the casks. **Porter** is made with roasted or dark brown malt, and contains alcohol 5 to 7 per cent. and extract of malt 7 or 8 ; **stout** is a stronger kind of porter. In the manufacture of these liquors, the malt is infused in water, and the infusion or **sweet-wort** is fermented with yeast, *Torula cerevisiæ*, at a temperature of 15° to 18° C. ; the yeast or **barm** rises to the surface, and is skimmed off ; the *bitter* flavour is given by hops and other vegetables. Analyses of these liquors show them to contain : Alcohol, 1 to 10 per cent. ; dextrin, maltose, and cellulose, 4 to 15 per cent. ; free organic acids, as malic, gallic, lactic, and acetic ; free carbonic acid gas, usually about 2 cubic inches per fluid ounce of liquid ; mineral salts from the water and malt ; and vegetable principles derived from the material used to bitter it, as—

Hops, the dried catkins or strobiles of *Humulus lupulus*, collected from the cultivated plants ; they consist of scales enclosing the so-called nut, which are covered with a yellowish powder, the superficial glands or aromatic bodies called **lupulin**. Hops

contain **valerol**, an aromatic oil which gives the aroma; **lupuline**, an alkaloid; and **lupulinic acid**, the bitter principle, besides tannin, resin, wax, and extractive. The oil, resin, and acid, are constituents of value to the brewer; the oil is firstly a stimulant, secondly diuretic, sedative, and soporific; lupulinic acid is a tonic and bitter stomachic, and these principles, combined with the alcohol, make the beer wholesome, promote sleep, and arouse and strengthen the appetite in low states of the system.[7 14] The use of other bitters in making beer is quite legal—*e.g.*:

Gentian root contains 0·1 per cent. of gentio-picrin, gentianic acid, gum, sugar, and a trace of volatile oil. It is an agreeable and slightly aromatic bitter, a tonic and stimulant to the stomach and bowels, and slightly disinfectant.

Chiretta, a dried plant of Northern India, contains an active bitter principle, **chiratin**, and **ophelic acid**, but no tannin. *Centaurea calcritraps* and *Cnicus benedictus* contain **cnicin**, a very bitter principle. *Menyanthes trifoliata* contains a bitter principle, **menyanthin**, and a volatile oil. *Mezereon* contains **daphnin**, and aloes has **aloin**. *Artemisia* has **absinthin** and a volatile oil. *Quassia* contains **quassin**, a very bitter principle. These and other vegetables are used in the manufacture of malt liquors. They are very bitter. Most of them are pure stomachic tonics, and in moderate proportions are not harmful. They invigorate the body whilst they increase appetite, and are thereby the means of introducing an increased amount of nutriment into the system, which is the main reason and value of such beverages.

Considered as articles of diet, malt liquors produce effects which are due in part to the alcohol and in part to the bitter and other principles contained in them. They encourage appetite and assist digestion, and promote sleep when they are bittered with hops. They are therefore useful in some forms of indigestion and debility, especially in persons who are enfeebled by disease, overwork, strain, mental worry, neuralgia, and similar troubles. They are nutritive in proportion to the saccharine and albuminous matters contained in them. Little can be said against the moderate use of malted alcoholic liquors; but it has been proved that work of all kinds is better done without them. When taken *in excess* their effect is the same as that of other

forms of alcohol. In particular, they cause corpulence and obesity, and by their interference with oxidation and elimination of the waste materials of the tissues they lead to gouty and other diseases which result from the accumulation of uric acid and its allies in the system. Plethora, hyperæmia of the liver and its sequelæ, are common consequences.[89 90]

Cider and Perry.—Cider was the name formerly given to a drink made from the juice of any fruit mingled with strong liquors, but is now always understood to be the fermented juice of apples. Perry is a pleasant, wholesome beverage, consisting of the fermented juice of pears. In large manufactories the juice is obtained by expression from the fruit. It is then exposed to the air at a temperature of about 60° F., and undergoes fermentation, the ferment being in the air. Dregs and scum are removed by racking and filtration. Sometimes albuminous substances are precipitated by the use of materials, like catechu, which contain tannin; acidity, when excessive, is neutralized by alkalies; 1 pint of milk being added to 9 gallons for the purpose of *fining*, and preservatives—*e.g.*, boric or salicylic acid—are put in by some makers, the latter in the proportion of 1 ounce to 96 gallons. The average composition of apple juice or *must* is stated by Allen to be—total solids, 19·7 per cent.; acidity (reckoned as H_2SO_4), 0·21; sucrose, 2·50; glucose, 13·58; pectin and albumin, 1·2; tannin, 0·29; and of pear juice or must—total solids, 21·95 per cent.; acidity, 0·15; sucrose, 3·67; glucose, 14·56; pectin and albumin, 1·31; and tannin, 0·18.

The composition of cider according to E. Grignon and A. H. Allen is here given:[91]

	French Ciders.				Renourri.	Average of all Kinds.
	Sweet Sparkling	Sweet.	Dry.	Dry.		
Alcohol, by volume	3·8	4·1	5·4	5·4	7·0	6·0
Extract	6·41	6·40	3·03	2·95	2·22	2·47
Ash	0·29	0·28	0·27	0·26	0·24	0·27
Acidity, as H_2SO_4...	0·36	0·39	0·52	0·58	0·54	0·52
Sugar	3·47	3·75	0·65	0·58	0·27	—
Alcohol, after complete fermentation	5·9	6·3	5·8	5·7	7·1	—

The products of the fermentation of apple juice or must are various, and they might be classified and sold as sweet, dry, or sparkling cider. Perry closely resembles cider, but has a sweeter taste, from the smaller proportion of malic acid in the must. Allen gives the following analyses[92] of Worcestershire and Devonshire perry, and quotes that of Gloucestershire by Pembrey :

Sparkling Perry.	Worcestershire.	Devonshire.	Gloucestershire.
Alcohol, by weight...	4·61	4·81	3·64
Equal to proof-spirit	10·11	10·54	7·98
Total solids	6·51	5·49	4·50
Volatile acid, as acetic	0·41	0·35	0·22
Fixed acid, as malic	0·25	0·20	0·24
Glucose	2·71	3·60	0·36
Sucrose	none	0·31	—
Ash	0·40	0·28	0·30
Original Solids	16·61	16·92	12·33

Cider and perry contain the stimulating and fragrant ethers found in champagne. Medicinally they are useful in cases of gout, rheumatism, gravel, stone, kidney diseases, and especially for those who have a tendency to obesity. *Dry* cider, on account of its freedom from sugar, is the best.

Koumiss.—An alcoholic beverage made from the milk of mares and other animals in Tartary. The composition of koumiss made with **mare's milk**, according to Hartier, is as follows: Alcohol, 1·65 per cent., fat, 2·05; lactose, 2·20; casein, 1·12; salts, 0·28; carbonic acid gas, 0·78. That made of **cow's milk**, according to Wanklyn, has the following composition: Alcohol, 1·60 per cent.; fat, 0·30; lactose, 4·85; casein, 1·07; salts, 0·75; carbonic acid gas, 1·50.[93] **Kephir** is the name applied by the inhabitants of the Caucasus to the fermented milk of mares.

Although koumiss is an alcoholic beverage, the proportion of alcohol in it is so small that it may be almost disregarded, except when a large quantity is consumed. On the other hand, a quart of koumiss contains 970 grains of various kinds of nutriment, each in a state to promote the digestion of the other in the weakest

stomach. It is therefore a valuable agent. The lactic acid in it augments the digestive powers, diminishes temperature and the frequency of the pulse, and regulates mucous secretion. The casein, albumin, and fat are nutritive, and promote assimilation; the lactose provides heat and energy, and increases weight; the alcohol, small as it is, encourages sleep, diminishes fever, and by oxidation develops heat and energy; the carbonic acid gas allays nausea, calms gastric irritation, increases the flow of urine, and diminishes the frequency of the heart, but augments the force of its contraction. Milk is one of the chief dietetic remedies in therapeutics, comprising all the nutritive requirements of the body; but, perfect as milk is, disease sometimes enfeebles the digestive organs so that it cannot be digested in sufficient quantity to maintain life. In such cases koumiss will be useful. It may also be given in certain cases of diabetes, Bright's disease, functional diseases of the urinary system, diseases of the nervous system, consumption, chronic gastric catarrh, and chronic pharyngitis or laryngitis. Sometimes, when living almost entirely on koumiss, the patient has put on a pound of flesh per week, the flesh has become plump, the complexion a fresh colour, and the digestive organs improved.[94]

The following mode of preparing koumiss from cow's milk is given by Davis: Take 24 ounces of milk, 8 ounces of water, 5 drachms of brown sugar, 48 grains of compressed yeast, 6 drachms of milk-sugar. Dissolve the milk-sugar in the water; rub the yeast and brown sugar together in a mortar with a little of the mixture; strain it; add all together; put the liquid in bottles and wire them. Keep at a moderate temperature for a few days. Shake each day, to prevent clotting of the casein. The acid stage is reached in a few days, when the preparation is much thicker and in a proper condition for use.[95] It should now be stored in a cool place.

Methylated-Spirit Drinking.—Methylated spirit contains 90 per cent. of raw spirit (**ethyl alcohol**) and 10 per cent. of wood spirit (**methyl alcohol**)—that is, twice as much alcohol as good whisky or brandy—and its cheapness and unrestricted sale places it within easy reach of everybody. No restriction is put upon its sale beyond the license which the retailer must hold; consequently, much evil results from its consumption as a stimulant.

A legitimate use for methylated spirit exists in the arts and many trades, whence it is most difficult to ascertain whether the liquid is purchased for trade purposes or to be drunk. *Commercial* methylated spirit contains 64 per cent. of alcohol, 10 of wood naphtha, and 2 of petroleum oil. It is a nauseous mixture, but, in spite of its unpleasant taste and odour, its consumption is rapidly increasing, and threatens to become a social danger.

The deleterious effects are due to the combination of three principles, which make it far worse than new or raw whisky. They are—new or immature alcohol; petroleum, which causes a form of intoxication; and naphtha, which produces the peculiar and characteristic effects of methylated spirit. Petroleum is readily removed by a little art, which the consumer soon acquires; but some of the tipplers like the drink better when the petroleum is not removed.

While acting as a powerful cerebro-spinal stimulant, methylated spirit produces a kind of intoxication, *not like drunkenness*, which is characterized by a state of mental exaltation, wakefulness, and a capacity for extended mental work very different from the drowsiness which follows the consumption of alcohol in its ordinary forms. It is rare to find anybody actually drunk from consuming it. The habitual methylated-spirit drinker is actively alert, and observes every detail. He is seldom talkative or seeks company, but is rather anxious for solitude. He develops a great capacity for lying, and his general appearance is that of a settled melancholy. Some of the drinkers are fond of tea; but when they are inured to the fiery taste of methylated spirit, the strongest whisky tastes weak in comparison and is despised, just as the ardent whisky-drinker despises milder liquors. The habitual consumption of such a powerful spirit produces speedy effects. Cirrhosis of the liver, Bright's disease, albuminuria, enlarged spleen, peripheral neuritis, and the worst forms of nervous disease, are a consequence.[96]

Ether-drinking.—The consumption of ether as an intoxicant is very prevalent in some countries, as France, and especially among the poor people of Ireland, on account of the cheapness of methylated ether. Thousands of gallons are consumed yearly, and the habit and its effects on the small farmers and labouring people, who are its chief consumers, is as pernicious as that of

opium-eating. The habit appears to have arisen about the time of Father Matthews' teetotal crusade, when people, forbidden to drink alcohol, found they could indulge in intoxication by drinking ether. The immediate effects of this narcotic stimulant are very similar to those of alcohol, but very much more rapid. The stages of excitement, mental confusion, and loss of muscular control and consciousness, follow each other so quickly that they cannot be clearly defined from one another.[97] It is always the methylated ether which is drunk, and usually in doses of 2 drachms or teaspoonfuls in water; but the inveterate drinkers can, by holding the nose, drink it without water, and *their* dose is usually half a wineglassful. The draught is repeated according to the desire or habit of the individual, sometimes ten or twenty such 'noggins' being drunk daily. It is, however, only the immoderate drinkers who go into a stupor. Many are content not to go beyond the stage of exhilaration or excitement, when they become talkative and laugh hysterically or act maniacally. The effect wears off rapidly, and the endeavour to renew the state of exhilaration induced by the first draught drives the consumer to take more and more of the stimulant, until it becomes a tyrannical abuse, leading to effects precisely opposite to those first arrived at.[98] If the dose is a very large one, the individual may fall down writhing and foaming at the mouth; but even this soon passes off, and leaves him low, feeble, and depressed, which induces a repetition of the dose. All ether-drinkers agree that the intoxication is pleasurable; but some know that it is a violent one, and the most violent intoxication is induced by drinking ether and whisky together.

The remote effects of ether-drinking are not well marked. There are no gross lesions like the shrinking of liver or brain produced by alcohol. It is like a thief which steals away the brains without leaving a visible mark of its presence. It also induces chronic gastric catarrh, indigestion, irregular action of the heart, great nervous prostration and trembling, and causes a white or sallow complexion, but sometimes a very livid one.[99] One of the most terrible effects of ether-drinking is the profound moral degeneration which it produces, lying and stealing to obtain their favourite tipple being induced just the same as in other forms of narcotism, and the districts in which the habit prevails

always provide a large number of inhabitants for the lunatic asylums. There may be no direct connection between lunacy and ether-drinking, but the habit and the nervous degeneration which it induces are predisposing causes of lunacy.

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CHAPTER XVIII

WATER

Water, which is a combination of hydrogen and oxygen, forms more than half the bulk of our body. Our daily requirement amounts to 70 or 80 fluid ounces; its consideration is therefore a matter of prime importance. Water is an absolute necessity of life; without it all living things would be dried up and life cease to exist. So important is it to mankind that the ancient towns and villages always grew near to such a water-supply as a river, stream, spring, or where it could be obtained by digging a well. The advantages of an abundant supply of pure water were written about by Hippocrates, and later by Pliny and other ancient writers. The cost of a pure water-supply to cities has always been a considerable item. In India, Ceylon, Carthage, and other places, the remains of large reservoirs are to be seen, and aqueducts exist in Rome and elsewhere. In modern times millions of pounds are spent in providing this necessary element for large cities, to bring it from gathering-grounds far distant from the consumers, in storing and distributing it, or in sinking artesian wells to bring it up from the enormous underground lakes and reservoirs.

The amount required by the body is in proportion to that which leaves the body daily through the skin, lungs, and kidneys, the average of which is 4 pints. Probably one-third of this is made good by our food, leaving from 2½ to 3 pints of liquid to be drunk daily in the form of water, tea, coffee, cocoa, milk, beer, or other beverage. *Pure water is by far the safest and best beverage*, and should be taken with or at the close of the meal, or about a couple of hours afterwards. A moderate amount of water drunk slowly at the end of a meal stimulates the contractions of the stomach, disperses wind, dilutes any undue acidity, and in this manner promotes digestion. Internally it acts as a diluent of the blood, as a solvent of waste materials which it carries away, and promotes changes in the cellular tissues or metabolism. It is of great value by flushing the kidneys and dissolving or washing out from the tissues those waste materials of metabolism which are so productive of

gout, rheumatism, gravel, liver, kidney, and other diseases, and is useful even in Bright's disease and diabetes. Healthy persons should drink a tumblerful of cold water slowly at *the end* of their meals; weakly or thin persons may encourage their appetite by taking it in frequent sips during the meal; it assists them to take more food, by its absorption it fills out their intercellular spaces and improves their health or increases weight. Excessive water-drinking may, but rarely, cause weakly individuals to waste and become thinner, and increase nervous irritability.

Good drinking-water should be clear, bright, and sparkling, almost without colour or taste, and quite free from smell. It should be obtained from some well-known and uncontaminated source, and yield but little residue when evaporated to dryness. There should be no undue proportion of solids, especially of lime or magnesia salts; ordinarily the solids ought not to exceed 8 or 10 grains per gallon; even in chalk water there should not be more than 14 grains, 1 grain of which should be dissipated by heat. The amount of albuminoid ammonia should be less than 0·08 per million parts; water which contains 0·05 per million in company with much free ammonia should be looked upon with suspicion. It should contain very few micro-organisms, especially bacteria. Chemical analysis no longer holds the first or most important place in the examination of drinking-water. The determination of the presence of nitrites by chemical examination is enough to excite suspicion of the wholesomeness of the water; but the presence of micro-organisms, especially the *Bacillus coli communis*, streptococcus, and *B. enteritidis sporogenes*, is of more importance than chemical substances, and they may be present in dangerous quantities in a water in which chemical analysis has not detected any important impurity. A bacteriological analysis is therefore necessary before pronouncing upon the fitness or otherwise of a particular water for household consumption; and it is of more importance to determine what type of bacteria are present by the microscope than the number per c.c. Koch formulated the following bacteriological standard for waters:

With	0 to 100 bacteria per c.c.	it is	a good potable water.
,,	100 to 500 ,,	,,	a suspicious water.
,,	500 to 1,000 or more	,,	an impure water.

Very hard water is a cause of goitre and cretinism, which are common in some countries of Europe, but are not common in Great Britain, although they are seen in the South of England and Derbyshire; it is likewise credited with being a cause of stone in the bladder or kidneys, and undoubtedly aggravates gouty and rheumatic conditions.

Water is derived from the rain and snow which fall upon the earth's surface, having been previously evaporated from the sea, lakes, rivers, and vegetation. Some of the rain which falls upon the earth percolates through the soil to a variable depth, and forms the subterranean sources of water which find a natural outlet in springs, or supplies the wells which are dug by man in the strata of the earth.

Water is pure as it leaves the clouds, but in its passage to the earth it absorbs various impurities; among these are small proportions of ammonia, nitric and nitrous acids, and, near the sea, chloride of sodium. In towns, it likewise absorbs sulphurous acid from the coal and gas consumed, besides sooty particles, and, in running off roofs, animal and vegetable débris. In addition to chemical ingredients, it collects from the air numerous microbes—bacteria, bacilli, micrococci, protococci, pollen of flowers and grasses, spores of fungi, etc. In the first showers which followed a long dry time, Dr. Miguel found over one hundred thousand of such organisms in a pint of water. An analysis of rain water, the first which fell in London after a long dry time in 1903, showed it to contain, according to the *Lancet*, the following: Total solid matter, 9·1 grains per gallon, including common salt 0·8, ammonium sulphate 0·65, organic ammonia 0·01, soot and suspended matter 5 grains. The ammonium sulphate and soot were largely due to the combustion of coal. The rainfall for five days was 3·8 inches, and was calculated equal to 22,622 gallons of water per acre; it washed out of the air of the county of London 3,738 tons of impurities, including 330 tons of common salt, 267 tons of sulphate of ammonia, and 2,000 tons of soot and other suspended matters, whereby it is shown that rain is a mechanical, physical, chemical, and bacteriological purifier of the atmosphere.

Soft Water.—The rain is a great purifier of the atmosphere, for which reason the rain water of towns is entirely unfit for

drinking and cooking purposes. If rain water must be used for drinking and cooking purposes, which happens in some districts, it should be stored in as pure a condition as possible ; otherwise the cistern will soon get coated with slime and putrescent matters which poison the water. It should never be stored in lead, zinc, iron, or galvanized iron cisterns, nor collected from a metal roof, because of its solvent power ; drinking such water would probably produce symptoms of metallic poisoning. *It should always be filtered before drinking it.* Boiled soft water is the best for toilet purposes, especially for those who have a tender skin or desire to have a good complexion ; hard water, on the other hand, may cause roughness of the skin, or even a kind of eczema and other skin troubles in persons whose epidermis is thin or tender.

Hard Water.—Water which has been in contact with the earth and filtered or percolated through it has absorbed carbonic acid gas, and become thereby a ready solvent of some of the mineral constituents, especially those of the chalk, limestone or sandstone, which convert it into hard water ; indeed, the water from some springs contains a very large amount of saline and other mineral constituents which render it very hard and unpalatable, but valuable as a medicinal water. Another effect of the percolation of water through the earth is the removal of organic débris and micro-organisms (such water may again become polluted by passing through soil laden with impurities or by pollution of the well or spring). Hard water contains salts of lime and magnesia in solution, which may be beneficial to the health to a certain extent and under special conditions ; the absence of such salts is, at any rate, considered prejudicial. Thus, the city of Glasgow is supplied by a soft, clear water of great purity from Loch Katrine, but the prevalence of rickets in the children of that city is attributed to the absence of lime from the water ; on the other hand, the absence of lime and magnesia from water is of great economical value to the people, for the softer the water the less soap is required. Loch Katrine contains 1 grain of lime per gallon, and is called a *soft water ;* ordinary drinking-water contains from 3 to 10 or more grains of lime per gallon, and the number of grains per gallon are called *the degrees of hardness.* One grain of carbonate of lime requires 8 grains of soap to precipitate it. The

hardness is said to be *temporary* when the water can be softened by boiling, the salts being deposited as slate or fur upon the kettle or boiler; the degrees of hardness which cannot be removed by boiling are called *permanent*, and are due to the presence of salts of lime and magnesia, which are not held in solution by carbonic acid gas.

Drinking-waters are classified thus by the Rivers Pollution Commissioners:

Wholesome	1. Spring water. 2. Deep well water. 3. Upland surface water.	Very palatable.
Suspicious	4. Stored rain or soft water. 5. Surface water from cultivated land.	Moderately palatable.
Dangerous	6. River water to which sewage gains access. 7. Shallow well water.	Palatable.

I. **Surface waters** include upland, moorland, and river waters generally.

Upland water is that which flows down hills and mountains, forming rivulets and streams, and can be collected into reservoirs of sufficient capacity to supply a large town for several months. It is sometimes very soft, as that of Loch Katrine, gathered from the surrounding hills and used for the supply of Glasgow; sometimes it is discoloured, as that of the Wicklow hills, due to its having passed through peaty matter, when it should be filtered, although peat is not injurious *per se*. Upland water is usually very pure, and approaches more nearly to rain water in composition than that from any other source.

Moorland waters are derived from streams and rivers which pass through moorlands and uncultivated lands away from human habitations. They are utilized by Glasgow, Leeds, Halifax, Wakefield, Manchester, Liverpool, Swansea, Okehampton, etc.

The *rivers and streams* which pass through cultivated lands and valleys near towns and villages are used to supply water to some very important cities, as Aberdeen, York, Chester, and London; but they should always be regarded with suspicion, unless the catchment areas are under the control of the authority which supplies the water, and they are duly guarded against pollution of animal origin by the entrance into them of

subsoil drainage from manured lands, or the sewage from towns and villages, or refuse from manufactories on their banks. Most river water is hard, containing 3 to 18 or even 25 grains of calcium and magnesium salts, their solution being aided by carbonic acid, derived from the soil over or through which it passes. The danger of river water is chiefly due to the possibility of organic impurities rather than to the salts contained, even the most careful preparation and filtration being scarcely adequate for its entire purification from bacteria.

II. **Springs.**—Some of the rain which falls upon the earth's surface evaporates, another portion flows off, and the remainder sinks into the soil. The water percolates through the porous strata, such as sand, sandstone, gravel, or chalk, until it reaches a hard, impermeable stratum of clay or rock; such a firm stratum forms an underground basin or reservoir in which the water accumulates, the level in it varying according to the rainfall and season of the year. From such sources are wells and springs supplied. As it passes through the earth the water is deprived of those impurities which it absorbed while falling as rain or flowing over the surface of the ground, but the carbonic acid in it renders it a ready solvent of lime, magnesia, and other salts, which make the water hard, but palatable. Water which has passed through the chalk or oolite is very efficiently filtered, and so is that filtered through sandstone, greensand, or Hastings sand. Much less efficiently filtered are those which have merely passed through the upper strata of the earth. Springs afford good supplies of water; they are formed by the appearance on the surface or the 'outcrop' of the impermeable stratum, which prevents the water from sinking further into the earth. The underground water is constantly tending to its level by the aid of gravitation: the earth's strata dip down, so the water trickles slowly through the interstices of the earth to the lowest level of the impermeable layer which forms the underground basin or reservoir, and where such a layer crops out on the surface of the earth the water springs forth. Such a spring is valuable, and should be guarded from pollution by building around it, and conveying the water to the surface by a short pipe. Many towns derive their supply wholly or partially from such springs, as Bath, Cheltenham, Bristol, Stroud, Bournemouth, Chepstow,

Poole, Swindon, and Yeovil; and the waters contain solid constituents, varying from 8 to 42 grains per gallon.

III. **Wells** are deep or shallow perforations of artificial origin into the crust of the earth. *Deep wells* are such as perforate the hard, impermeable layer which holds up the water of shallow wells. The water has usually travelled a great distance since it fell upon the earth; it is, therefore, generally well filtered and palatable, and naturally free from organic impurities, and hard by reason of its containing 18 to 80 grains of earthy salts per gallon. Many towns and cities derive their supply partly or wholly from such sources, as Birkenhead, Southport, Coventry, Wolverhampton, Warrington, Nottingham, Harwich, Leamington, Windsor, Worthing, Guildford, Stroud, Sudbury, Colchester, Canterbury, Folkestone, Brighton, Eastbourne, and Hastings. Deep wells are liable to become polluted when in the neighbourhood of sewage farms, cemeteries, or isolation hospitals, and in other ways; it is therefore advisable that they should be bricked and steined to a good depth to exclude all possible contamination by surface water. When so protected they seldom become polluted, although it may even then be possible for the liquid from sewers, cesspools, or crew-yards to find its way through cracks or fissures in the rock, and be a source of danger to the consumer. *Shallow wells* are such as tap the subsoil water, which is held up by an impermeable stratum, so as to form small superficial basins or reservoirs. Most wells in the country belong to this class; they vary from 12 to 30 or more feet in depth, and are very liable to be polluted. 'The common practice in villages, and even in many small towns, is to dispose of the sewage and provide for the water-supply of each cottage on the premises. In the little yard or garden attached to each tenement or pair of tenements two holes are dug in the porous soil. Into one of these, usually the shallower, all the filthy liquids of the house are discharged; from the other, which is sunk below the water-line of the porous stratum, the water for drinking and other domestic purposes is pumped. These holes are frequently within 12 feet of each other, and sometimes closer. The contents of the cesspool gradually soak away through the surrounding soil and mingle with the water below; as the contents of the well are pumped out they are replenished from the surrounding

disgusting mixture' (The Rivers Pollution Commissioners Sixth Report).

It was estimated in 1893 that twelve million people in Great Britain were drawing their water-supply from shallow wells. It has been found that such a well drains an area of ground at least four times its depth in every direction around it. The common experience of sanitary medical officers and inspectors is that they are nearly always more or less polluted by sewage and animal matters of the most disgusting origin. When such a water is filtered through a few feet of soil, it may be very clear and palatable, and is often consumed year after year without its character being suspected, until the cesspool and well receive sewage which is infected by disease, and an outbreak of such disease compels attention to the well. Such wells are polluted by leakage from drains, privies, cesspools, urine from manure heaps or crew-yards; the putrid matters percolate into the soil, and may be washed straight into the well during a heavy rain. A water which is usually bright, clear, and sparkling, having a pure and deceptive appearance, may become after rain so turbid and unpleasant to smell and taste that nobody would think of drinking it. If a portion of such water be put in a bottle, corked down, and kept in a warm place for a short time, it will be very productive of living forms, recognisable under the microscope, and the following simple test for organic matter will reveal its impurity: To a tumblerful of cold water fresh from the well add as much Condy's fluid or permanganate of potash as will produce a ruby colour. Cover the tumbler to exclude dust and other extraneous particles, and the organic matter in the water will be oxidized and deposited as a brownish sediment, or the colour of the liquid changed to a dirty brown or red. The amount of sediment is a test of the purity of the water; the less deposit there is, the purer the water, and *vice versâ*. If the colour wholly or partially disappears after a few minutes, organic matter is present in quantity, but if it retains its colour for twelve hours and no sediment appears it may be considered uncontaminated. A water of known purity, as tap water, distilled water, or rain water, freshly collected in a clean vessel, can be tested at the same time for comparison. Distilled water is the best, and will retain its colour. A water which contains much

deposit when tested in this rough-and-ready way should be submitted to an analyst for examination before being used for domestic purposes.

The pollution of wells may be prevented by proper attention to their construction, as well as that of the other sanitary arrangements of the premises. The **drains** upon the premises should consist of glazed earthenware pipes with socket-joints, made with Portland cement or well-puddled clay; cesspools and privies should be made watertight by cement; manure should be stored in proper pantapits, which are drained. The well should not be sunk within an area which is liable to be contaminated by the foregoing sources of pollution—that is, they should not be within four times the depth of the well in every direction. The drainage into the well varies with the nature of the soil or subsoil. Thus, a well will drain an area of gravel or fine sand equal to twenty or forty times the depression of the water in it; or an area of coarse gravel equal to sixty-eight or one hundred and sixty times the depression of the water; or even a larger area of sandstone, chalk, or other rock in which there may be extensive fissures. Owing to smallness of the area of land, it is not always possible to have the well so far away from the other sanitary arrangements; the well ought then to be bricked down to the impermeable stratum, and the bricks laid in cement to exclude surface-water and the possibility of pollution by unsavoury matters from the midden, cesspool, drains, or manure-pit.

Besides organic pollution by the bacteria of disease and from the sources named above, the water may contain hosts of other microbes and fungi, such as the *Beggiatoa alba* or sewage fungus, amœbæ, infusoria (vorticellæ, paramecia, stentor), anguillulæ or water-worms, rotifera or wheel animalculæ, *Daphnia pulex* or water-flea, the larvæ of gnats and other insects, the embryo or eggs of various worms, such as tape, round, or thread worms, distoma or liver-fluke, and filaria or bilharzia, which may all infect the human organism. Other refuse in the water may consist of the fibres of cotton, linen, paper; even hairs and other animal matters have been found, indicative of pollution of human origin, probably by sewage. Water likewise has the power of absorbing gases, which may gain access to it in a thousand ways; it should, therefore, never be stored in the house in an open

vessel, for under the most favourable circumstances it deteriorates, becomes flat and insipid, and may get polluted. It is, unfortunately, in the houses of the poor where there is the necessity for this; it is often stored in wooden butts or other vessels, which are liable to rot or become filthy. Water should be freshly drawn from its source when it is required for drinking or cooking, thereby avoiding the accidental contaminations to which it is liable when stored for a few hours.

The water-supply of towns and cities is a matter of great importance, seeing that impure water is a frequent cause of disease to those who drink it, and deficiency of this element means want of cleanliness and comfort, with its concomitant dangers. The supply of water to towns from a distance may be constant or intermittent. *A constant supply* is preferable, the mains being constantly charged with water, and no storage being required. When the supply is *intermittent* the mains are not always charged at high pressure, and water can only be drawn at certain periods of the day; storage is therefore necessary. The storage of water is a great drawback to the intermittent form of water-supply; stored water becomes flat and insipid, and is liable to become polluted in many cases by sewer air, soot, dust, and other accidental forms of contamination. The cistern in which it is stored may be a source of danger. Thus, zinc and lead are sometimes soluble, and water stored in cisterns of these materials may give rise to poisonous symptoms; iron may rust and discolour the water; galvanized iron is usually safe, but has been known to give zinc salts to the water; slate makes a valuable cistern, but the joints should be made with cement, and not with red or white lead. Stoneware cisterns are the best: they give up nothing to the water, and are easily cleaned. The supply of water through **leaden pipes** is a possible source of danger to the consumer. A soft water acts most readily on lead, and dissolves a small portion of the oxide of that metal; but hard water, which contains the salts of lime and silica, has little power of dissolving lead—in fact, by their precipitation the salts soon form a protecting coat of fur or slate over the interior of the pipe, and so effectually prevent any further solution of the metal. This has been imitated in some towns which have a soft-water supply by filtering the liquid through beds of flint or sand and a thin

coating of lime, so that enough lime and silica are taken up to harden the water, and give a protective coating to the leaden pipes. Another source of lead solvency lies in the fact that some of the waters are derived from districts in which peat abounds; such waters are slightly acid, owing to the presence of two special bacterial organisms derived from the peat, and the acidity which they produce renders them a solvent of lead, and has been the cause of epidemics of lead-poisoning, as at Sheffield.

The purification of water is done on a large or small scale by methods of filtration. Pure water is clear, bright, and sparkling, of bluish or greenish colour, tasteless, and free from smell. Polluted water which is well aerated may also be clear, bright, and sparkling, but often has a disagreeable taste, and gives off an unpleasant odour upon being gently warmed. Such a water may be highly charged with organic impurities of a dangerous character and swarm with bacteria. By the purification of water a large amount of such impurities can be removed. Boiling the water softens it, destroys organic matters, microbes, fungi, infusoria, etc., and effectually destroys the bacteria of enteric, cholera, scarlet and other fevers, in a few minutes. Filtration removes this and other débris. When purification is done on a large scale, as for a town, Clark's process of 'driving out lime by lime' is used; by this method the *temporary hardness* of water is considerably reduced. When lime or lime water is added to hard water, more carbonate of lime is formed by the union of the added lime with the free carbonic acid of the water; when this occurs the newly-formed carbonate of lime and that which was previously held in solution by the carbonic acid gas are precipitated together, and carry down with them a good deal of the organic matter and other impurities of the water; the water is then allowed to settle for twelve hours, and afterwards filtered. Filtration is a useful mode of purification. When done on a large scale, the filter consists of tanks of brick 6 or 9 inches thick, open to the air, and having the bottom covered first with a layer of bricks, 6 inches; next gravel, 6 inches; and lastly sand, 2 feet 6 inches. This arrangement allows for the filtration of 4·5 cubic feet of water per hour through a square foot of area. After filtration the water should be stored in covered reservoirs to protect it from the sun and contamination. Water

can also be filtered on a small scale through gravel and sand, or through charcoal and magnetic or spongy iron. Filters are not all good; some of them become a source of pollution to the water owing to neglect or difficulty in cleaning them; hence water may be worse after being filtered than before it. The worst filters are those made of charcoal. Many good ones are sold, as Bischoff's spongy-iron filter, the Pasteur-Chamberland, and the Berkfield filters.

Diseases due to Drinking Impure Water.—Dyspepsia and diarrhœa may follow drinking very hard water, especially by visitors to a district drinking water which is harder than they are accustomed to. The symptoms are due to excess of lime and magnesia, or chlorides of other salts. Diarrhœa of a severe type may be caused by drinking water which is contaminated by sewage. It is not uncommon for people to drink such water for years without ill-effect—indeed, some persons are said to fatten upon it—but as soon as a stranger drinks it a very marked effect follows. Infantile diarrhœa in towns may be due to the use of water which has been stored in cisterns in the summer-time, when it becomes a hotbed of bacteria capable of causing this disease. Dysentery in hot climates is due to drinking water which contains the *Amœba coli*; cholera is also caused by drinking contaminated water. The same remark applies to enteric fever, which was largely spread during the South African War by the consumption of water contaminated by the excreta of fever patients. Many other diseases of a specific character are due to a similar origin; calculus, gravel, gout, rheumatism, and goitre may have their origin in or be aggravated by the consumption of very hard water. Care should always be taken to insure the adequate protection of the source of supply: the gathering-grounds and head-waters should be strictly examined to eliminate infection. Throughout their course waters should be covered in, and, finally, they should be filtered before being sent into the service-pipes for the supply of households. When river or well water is used, great care is required to insure its purity, especially when the source is in a confined area or the neighbourhood of a farmstead, by particular attention to the drains, cesspool, privy, or other possible sources of contamination.

NATURAL MINERAL WATERS.

The value of ordinary water as a dietetic beverage, as well as the solvent action of pure water upon the waste materials of the body, and its valuable effect in gout, rheumatism, lithæmia, and similar troubles connected with deficient oxidation and metabolism, has been already commented on. There are waters in almost every part of the globe which depart from the normal characteristics of drinking-water, inasmuch as they contain an excess of inorganic substances, salts of soda, lime, magnesia, potash, iron, manganese, iodine, bromine, lithium, barium, small traces of arsenic, copper, zinc, strontium, and the rarer elements—argon, helium, radium, and such gases as sulphuretted hydrogen, sulphurous acid, carbonic acid, nitrogen, and oxygen. An excess of these substances renders the water unpleasant or otherwise unsuitable for ordinary domestic purposes, but in many instances makes of it a valuable medicinal agent. The remedial value of such water is sometimes out of all proportion to the quantity of the principal elements contained in it. Thus, for instance, it would be an error to suppose that the value of a water was in proportion to the amount of gas contained in it, for a large quantity of the gas is expelled almost as soon as the water is swallowed; nor in proportion to the quantity of sulphate of sodium and magnesium contained in it. Many attempts have been made to imitate such waters in the laboratory; but, however admirably prepared, they are only pharmaceutical preparations, and are destitute of the qualities which distinguish those made in Nature's laboratory. For instance, a tumblerful of Friedrichshall water contains 24 grains of magnesium and 20 grains of sodium sulphates, with 30 grains of sodium and 19 grains of magnesium chlorides; but it is a curious fact that the artificial product is not at all equal in effect to that of the natural one. What constitutes the difference it would be very difficult to say, but the consensus of opinion is all in favour of the natural product. 'To give the name of Vichy Water to a solution of bicarbonate of soda is as absurd as to give the name of wine to a mixture of cream of tartar, alcohol, and mineral salts, which this liquid is proved to be when analyzed.

Go to the natural springs; Nature is far better than the laboratory' (Bousdon). Recent analyses prove that some of our mineral waters contain traces of radium, helium, and other rare elements. The **ions** dissociated from chemical compounds exert a great influence over the physiological processes of the body; and the presence of ions in an electrical condition probably makes the chief difference between natural and artificial mineral waters.

The general usefulness of mineral waters in the treatment of disease has been recognised for thousands of years. The Greeks and Romans highly valued all waters having curative properties, and they were strongly recommended by the medical men of their day—witness the remains of luxurious baths to be now seen in many places. It has been suggested that one cause of their usefulness is the high dilution of the mineral constituents, for many persons, who have taken the chief constituent of such waters in medicinal doses with little effect, have made good progress when they have taken mineral waters containing the very same drug. Sir H. Thompson said: 'Let me caution you against regarding the small doses of mineral in the water as having any affinity either in the matter of quantity or by manner of administration with what is understood as homœopathic doses. . . . There is something, which I do not pretend to explain, which distinguishes the action of natural mineral waters from the action of salts which are produced pharmaceutically.' It is true that the minerals in such waters are in a high state of dilution, which necessitates the drinking of a greater bulk of liquid. We have seen that water, even distilled water which contains no minerals, is a diluent and solvent, and a great promoter of the metabolic processes of the body; and water containing a drug like iodine, bromine, lithium, or the alkaline salts in a state of great dilution, when taken in bulk, flushes the cells with these constituents, and helps to bring about more rapidly those changes which result in the alleviation or cure of disease.

Balneo-therapeutics, or treatment by baths, has advanced considerably of late years, and its physiological effects are better understood than formerly, the mineral water being used for water, steam, or mud baths, as well as for douches, sprays, and inhalations. When combined with massage, electricity, proper

diet and exercise, or various other forms of discipline, they are a valuable method of treatment for many diseases. Baths of various degrees of heat are used: The **cold bath**, of 32° to 65° F., cools the blood and stimulates the heart and circulation; the **tepid bath**, from 75° to 90° F., is used for cleansing the skin and lowering the temperature; the **warm bath**, of 90° to 100° F., relaxes the skin, induces perspiration, and soothes pain or relaxes spasm; the **hot bath**, 100° to 110° or 115° F., seldom used as a general bath, but very frequently as a local bath or douche or fomentation, stimulates the circulation, softens indurated tissues, relieves pain, spasms, or cramp, promotes perspiration and the flow of urine. The fundamental principle of all baths, whether of plain or medicinal water, appears to be to soften and purify the skin, to encourage perspiration, accelerate the circulation, and stimulate the functions of the kidneys; the nervous system is calmed, muscular irritability lessened, metabolism increased, and absorption of exudations promoted. Discussion has taken place as to whether there is any actual absorption of the salts from mineral waters during a bath; some authorities deny that there is, others assert that there is a deposit of fine crystals upon the skin, which continue to exert their influence as a chemical and physical stimulus upon the terminal branches of the nerves for some period after the cessation of the baths.

Disappointment sometimes follows the use of mineral waters when taken by the mouth or applied to the skin. This may result from the fact that the patient is not acquainted with the proper method of using them, or that he has arrived at the health resort with obstructed functions and a general lowered tone of the body, which require preliminary treatment. Proper measures ought therefore to be taken under medical supervision to remove disorders of the digestive and assimilating organs and otherwise raise the tone of the system before undergoing the treatment at a watering-place. The pure air, out-of-door life, intelligently regulated diet, regular exercise and habits of a health resort, are valuable in a great number of diseases, and, when combined with drinking the water, the tissue changes are increased, toxic materials are eliminated, appetite is restored, and nutrition stimulated. Bathing with the water at a low or moderate

temperature stimulates the nervous system, and at a higher temperature calms it, increases the activity of the skin, deepens respiration, increases pulmonary circulation, and carries nutrition to the lungs and all parts of the body. In gouty and rheumatic diseases the entire system is invigorated, circulation and tissue changes are promoted, and the elimination of the *materies morbi* is encouraged. Even if there be no absorption of the mineral constituents by the skin, bathing and douching excites the peripheral circulation, and softens exudations, while absorption is further encouraged by massage. The hygienic mode of life, the relief from physical and mental tension, and change of scenery, all contribute to an improved general condition with marked success. Judicious hydrotherapy, combined with massage and electricity, has likewise been of value in many nervous cases. The spinal douche is an effective agent in stimulating nervous tissues and invigorating nerve centres. In irritable or hyperæsthetic conditions the nervous system may be calmed by warm baths and gentle massage, and drinking some of the mineral waters tones and invigorates the nervous system.

Attempt is here made to classify some of the most important waters in Europe and America. No pretence is made of this being a complete list, but sufficient examples are given to show the main constituents of the waters and the diseases for which they are most beneficial.

TABLE WATERS.

These are waters which may be consumed freely at all times—at meals, between meals, alone or combined with spirits, wine, fruit syrup, or milk. They vary in their chemical composition: some are gaseous, owing to the presence of free carbonic acid gas, which makes them bright, sparkling, and palatable; nearly all contain a varying proportion of alkaline carbonates and chlorides. Apollinaris and Seltzer waters are among the best known, and are alkaline and effervescent. Another kind of table water is that which has been distilled—*e.g.*, Salutaris, which has been first converted into steam and then condensed, and may be still or aerated; its purity is absolute. Table waters are not without

I. TABLE WATERS.

(Constituents in Grains per Gallon.)

Name.	Situation of Source.	Special Character.	Carbonates of Soda.	Carbonates of Lime.	Carbonates of Magnesia.	Chlorides.	Sulphates.	Free CO_2 (cubic inches).	Analyst.
Bath (Sulis) ...	England	Aerated	—	7·6	0·5	30·3	30	—	Attfield.
Alet	Aude, France	Alkaline	—	19·0	7·0	3·0	2	4·1	Filholl.
Chateldon ...	Puy de Dôme, France	Alkaline chalybeate	27·0	36·0	18·0	2·0	3·5	152	
St. Galmier ...	Loire, France	Alkaline	39	50	50	33	14	High	
Desaignes ...	Ardêche, France	Alkaline	215	14	10	7	0·3	211	Ferrand.
Apollinaris ...	Neuenahr, Germany	Alkaline	88	4	31	32	21	194	Bischof.
Selters	Nassau, Germany	Alkaline	58	17	14	0	163	High	Mohr.
Sauerbrunnen ...	Hartz, Germany	Very soft	0·2	0	0·9	0·4	—	—	Attfield.
Taunus	Frankfort, Germany	Saline	1·4	95	12	197	—	202	Taylor.
Wilhelmsquelle ...	Kronthall, Germany	Saline	3·5	29·2	6·7	118	1·6	157	Fresenius.
Ems	Germany	Alkaline	148·0	17	15	70	4·5	83	
Gerolstein ...	Eifel Mountains, Germany	Alkaline	57·0	40	31	17	7·0	—	
Johannisbrunnen	Nassau, Germany	Alkaline	25	51	21	72	2·0	170	Plaskuda.
Roisdorf	Bonn, Germany	Alkaline	60	21	30	146	—	190	Bischof.
Rosbach	Homburg, Germany	Alkaline	—	25	12	83	—	—	Wanklyn.
Birresborn ...	Prussia, Germany	Alkaline chalybeate	199	19	76	72	13	170	
Roman Spa ...	Ober-Hessen, Germany	Acid chalybeate	—	56	105	133	10	216	Fresenius.
Spa, 'Pouhon' ...	Belgium	Ferruginous	7·3	9·8	11·2	4·5	1	216	Struve.
Giesshübler ...	Carlsbad, Bohemia	Alkaline	68	15	3	3	—	—	
Orezza	Corsica	Ferruginous	—	42	5	—	—	75	
Poland	Maine, U.S.A.	Alkaline soft	0·1	1·2	0·5	0·2	0·1	—	Chandler.
Sweet Spring ...	Virginia, U.S.A.	Alkaline soft	—	37	11·0	0·8	36	88	Rogers.
Clymir Spring ...	Waukesha, Wis., U.S.A.	Alkaline soft	1·5	20	16·5	1·5	1·2	—	Rathbone.
Soda Spring ...	Alpine Co., California, U.S.A.	Alkaline soft	11·5	52	5·2	31·2	—	186	

(*Grains per Gallon.*)

Source.	Locality.	Altitude (Feet).	Special Character.	Sulphates of Magnesia.	Sulphates of Soda.	Sulphates of Potash.	Sulphates of Calcium.	Chlorides.	Carbonates.	Analyst.
(*a*) *European:*										
Apenta	Buda-Pest, Hungary	—	Strong	1,474	1,309	5·8	184·3	117·0	45	Tichborne.
Æsculap	Buda-Pest, Hungary	—	Strong	1,750	1,340	3·5	185·6	301	140	Tichborne.
Arabella	Buda-Pest, Hungary	—	Mild	339	237	—	23·0	13·0	23	Paul.
Birmensdorf ...	Switzerland	1,300	Medium	1,540	492	7·3	89·0	32	3	Bolley.
Carlsbad	Bohemia	1,000	Mild	—	199	3·6	87	—	117	Gottl.
Condal	Rubinat, Spain	—	Strong	215	3,123	36·0	115·7	130	—	École des Mines.
Franz-Josef ...	Hungary	—	Strong	1,725	1,684	—	129·5	117	—	Attfield.
Friedrichshall ...	Germany	920	Medium	434	364	—	—	869	—	Breslau.
Hunyadi-Janos ...	Hungary	460	Strong	1,564	1,579	8·5	—	119	105	Bunsen.
Hunyadi-Laszlo...	Hungary	—	Strong	1,692	1,611	6·3	127·5	92	47	Ballo.
Marienbad ...	Bohemia	1,900	Mild	140	387	4·9	—	154	123	Kersten.
Pullna	Bohemia	1,225	Strong	931	1,239	48·0	26·0	167	72	Struve.
Rubinat	Pyrenees, Spain	—	Strong	229	6,749	16·1	136·0	144	—	Bouchardat.
Victoria-Offener...	Budapest, Hungary	—	Strong	2,297	1,201	30·8	163·1	124	83	Roscoe.
(*b*) *American:*										
Dupont's Artesian Well	Louisville, Kentucky	—	Saline, gaseous	104	97	5·0	36·0	848	12	
Foley's Orchard Spring... ...	Lincoln Co., Kentucky	—	Mild	246	73	12·0	13	22	72	Peters.
Saloon Spring ...	Harrodsburg, Kentucky	—	Ferruginous	268	—	—	98	—	—	
Pogassa Spring ...	San Juan River, Colorado	—	Temp. 100° to 140° F.	—	157	5	—	22	52	Löew.
Glen Spring ...	Spartansburg, South Carolina	—	Sulphuretted	116	48	—	—	—	—	
Indian Spring ...	Butts Co., Georgia	—	Temp. 63° F.	697	—	34	68	—	—	
Seltzer	Colorado	—	Ferruginous	—	277	—	—	—	103	

III. ALKALINE WATERS.

(Constituents in Grains per Gallon.)

Source.	Situation.	Altitude (Feet).	Special Character.	Carbonates of Soda.	Carbonates of Magnesia.	Carbonates of Lithia.	Carbonates of Lime.	Sulphate of Lime.	Other Sulphates.	Chlorides.	Analyst.
Askern, Yorks...	England	—	Calcareous	—	—	—	91·3	56·5	27·7	33·0	Bottomley.
Bath (Sulis) ...	England	—	Ferruginous	—	0·5	—	7·8	94·0	—	30·3	Attfield.
Buxton... ...	England	600		—	4·7	—	9·1	0·6	1·0	4·5	O. Hehner.
Llangammarch	Wales	—	Barium, 6	—	—	—	2·8	—	—	298·5	Dupré.
Vichy (Celestins)	France	733	Alkaline	357·2	22·0	—	32·0	—	20·0	—	
Vals (Magdeleine) ...	Ardèche, France	2,475	Alkaline, gaseous	509·0	47	—	36	17·0	17·0	1·1	O. Henry.
La Bourboule ...	Puy de Dôme, France	2,600	Arseniate of soda, 1·9	202·0	—	—	13·0	—	—	211·0	
St. Galmier (Noël) ...	Loire, France	1,350	Gaseous, acidulated	21·0	25·0	—	47	5	8·0	5·0	
St. Galmier (Badoit) ...	Loire, France	—	Gaseous, acidulated	39·2	60	—	40·8	14·0	—	33·6	
Pougues ...	Loire, France	780	Calcareous, ferruginous	45·0	68	—	93	13	19	25	O. Henry.
Contrexéville (La Cler) ...	Vosges, France	3,100	Calcareous	0·5	2·0	—	28·0	97·0	17·5	0·5	
Contrexéville (Pavillon) ...	Vosges, France	3,100	Calcareous	—	2·5	0·28	28·0	81·0	18·0	0·6	Debray.
Fuiggi	Italy	—	Nitrate of potash, 22·4	—	102·0	Trace	17·0	60	—	22	Cannizaro.
Apollinaris ...	Ahr, Germany	225	Gaseous	66·0	28·0	—	17·0	—	21·0	—	Mohr.
Bilin	Bohemia	—	Lithiated	235·4	12·0	7·4	28·4	—	66·7	26·7	
Bonifacius ...	Nassau, Germany	825	Saline, lithiated	—	—	15·0	46·0	109	21	785·0	
Ems	Lahn, Germany	291	Alkaline	152·0	14·0	—	18	—	4·0	77·7	Fresenius.

Fachingen ...	Nassau, Germany	337	Chalybeate	280·8	23	Trace	29	—	—	46·0	Fresenius.
Roman Spa ...	Ober-Hessen, Germany	—	Ferruginous	—	105·0	—	56·0	9·6	—	134·0	Fresenius.
Selters	Ober-Nassau, Germany	800	Gaseous, aperient	58.0	14·0	—	17·0	—	163	—	Mohr.
Taunus... ...	Frankfort, Germany	390	Saline, gaseous	1·4	12·0	—	96	—	—	189·0	Taylor.
Wildungen ...	Waldeck, Germany	300	Alkaline	4·7	36·0	—	50	—	13	0·7	Werner.
Carlsbad (Sprudel) ...	Bohemia	1,227	Aperient	90·0	4·0	—	20	—	200	87	Gottl.
Giesshübel ...	Bohemia	—	Alkaline, gaseous	83·4	14·9	0·7	—	—	2·0	2	
Kronenquelle ...	Silesia	—	Ferruginous	61·0	28·3	0·78	46	—	15	4	Poleck.
Tarasp	Switzerland	4,600	Iodide, 15	272·0	50	—	124·3	—	190	—	Von Planta.
Bethesda ...	Wisconsin, U.S.A.	—	Alkaline, ferruginous	2·0	18 0	—	25	—	1·5	1·5	Chandler.
Buffalo Lithia (2)	Virginia, U.S.A.	500	Carbonate of potash, 30	—	—	2·2	14·9	33	10	6	Tenry.
Saratoga-Vichy	New York, U.S.A.	—	Saline	100	50	2·6	114	—	—	200	Approx.
Ojo Caliente ...	New Mexico, U.S.A.	—	Thermal, ferruginous	138	1·5	0·15	—	—	4	38	Marsh.
Adam's Spring	Lake Co., California, U.S.A.	—	Gaseous	68	119	—	35	—	—	—	
Seltzer Spring	Mendocius, California, U.S.A.	—	—	42	52	—	79	—	—	—	
Congress Spring	Clara Co., California, U.S.A.	—	Ferruginous, 15	148	—	—	—	—	—	124	
Borate Spring ...	Lake Co., California, U.S.A.	—	Ammonia, thermal	103	—	—	—	—	—	101	
Geneva Red Cross ...	Lake Co., California, U.S.A.	—	Lithia	—	14·6	11·6	42·0	18·7	123	—	
Harris Lithia ...	South Carolina, U.S.A.	—	Silica, 3	3·0	3·6	2·8	—	100·4	—	0·9	Doremus.
Hot Springs ...	Arkansas, U.S.A.	—	Silica, 2·5	0·04	1·1	—	7·5	—	1·2	—	Brunner.

IV. BRINE OR SALINE WATERS.

(Grains per Gallon.)

Source.	Locality.	Altitude (Feet).	Special Character.	Chlorides of Soda.	Chlorides of Lime.	Chlorides of Magnesia.	Salts of Lithia.	Bromide and Iodide.	Carbonates.	Analyst.
(a) European :										
Aix-la-Chapelle ...	Rhenish Prussia	450	Sulphur, 63° F.	202	—	—	—	0·3	67	Liebig.
Bonifacius	Hesse-Nassau	825	Lithiated, 51° F.	717	—	69	15.2	0·6	47	
Homburg	Hesse-Homburg	600	Calcareous, ferruginous	791	—	78	—	—	135	Liebig.
Kreuznach	Rhenish Prussia	285	Lithiated	728	133	40	6·3	2·7	26	Löwig.
Kissingen (Rakoczy)	Bavaria	600	Manganese, 41	407	27	21	1·4	0·5	75	Liebig.
Nauheim	Hesse-Nassau	500	No. 12, Temp. 91° F.	2,050	14	—	3·5	—	12	
Roman Spa... ...	Hessen	—	Gaseous	116	13	—	—	—	165	Fresenius.
Taunus	Frankfort-on-Maine	390	Table	180	—	—	—	—	108	Taylor.
Wiesbaden	Nassau	346	Muriated	525	36	15	0·1	0·28	33	Fresenius.
La Bourboule ...	Puy de Dôme, France	2,600	Arseniated, 1·96	799	—	2	—	—	316	Bouis.
Salins les Bains ...	Jura, France	1,054	—	1,592	—	61	—	2·15	—	
Salsamaggiore ...	Lombardy	—	Calcareous	693	71	26	3·3	1·6	—	Nassini.
Tarasp (St. Lucius)	Switzerland	4,600	Chalybeate	294	—	—	—	15·3	175	Von Planta.
Leamington... ...	England	—	Aperient	688	166	94	—	Trace	—	Cutting.

Woodhall Spa ...	England	—	Iodized and chalybeate	1,330	111	91	—	5·0	10	Wanklyn.
Boston Spa ...	Yorks, England	—	Barium, 28	733	48·8	39	—	—	18	Richards.
Llangammarch ...	Wales	600	Barium, 6	197	84	24	trace	trace	4	Dupré.
(*b*) *American:*										
Alba Salt Spring ...	Bradford, Pa.	—	—	5,634	936	133	—	trace	8	Genth.
Alkesion Spring ...	Saline Co., Miss.	—	—	907	100	104	—	0·15	48	Williams.
Albany Artesian ...	Albany, N.Y.	—	—	602	—	—	—	—	75	Approx.
Halbeck	Oneida, N.Y.	—	—	754	130	38	—	—	—	Noyes.
Blue Lick	Kentucky	—	—	621	48	—	—	—	77	Approx.
Boulder Spring ...	Colorado	—	—	617	—	—	—	—	266	Approx.
Dupont's Well ...	Louisville, Ky.	—	—	747	79	18	—	1·2	9	Approx.
Otto's Well	Crawford, Ia.	—	—	4,737	—	—	—	—	500	Approx.
Salina Spring ...	Tarentum, Pa.	—	—	2,327	610	138	—	—	300	Approx.
Connemaugh Salt ...	Saltsburg, Pa.	—	—	4,998	1,002	280	—	—	—	
Iola Well	Kansas	—	—	739	—	—	—	—	95	
Thomas' Brine Well	Fountains Co., Ia.	—	—	5,488	258	64	—	—	—	
Saratoga	New York	—	—	60	—	—	0·45	1·3	27·5	Chandler.
Hathorn Spring ...	Saratoga, N.Y.	—	—	Total Chlorides		722	—	—	460·0	
Olympia Spring ...	St. Clemens, Mich.	—	—	6,858	5,616	2,888	3·27	—	—	
Clementine Well ...	St. Clemens, Mich.	—	—	5,684	2,827	1,228	trace	—	—	Tronelle.
The Medea Spring ...	St. Clemens, Mich.	—	—	5,957	4,128	1,656	—	8·1	—	Duffield.

V. CHALYBEATE OR FERRUGINOUS WATERS.

(Grains per Gallon.)

Source	Locality.	Special Character.	Carbonates of				Sulphate of Iron.	Other Sulphates.	Chlorides.	Analyst.
			Soda.	Lime.	Magnesia.	Oxide of Iron.				
(*a*) *European :*										
Bath (Sulis)	England	Aperient.	—	7·8	0·5	1·2	—	94	30·1	Attfield.
Flitwick	Bedford, England	Astringent	—	—	—	—	170·8	46·6	—	*Lancet.*
Leamington Spa ...	Warwickshire, England	Saline	—	—	—	0·8	—	287·0	1,219·0	Cutting.
Harrogate	Yorkshire, England	Sulphur	—	12·3	—	Trace	—	—	1,602·0	Hoffman.
Bussang	Vosges, France	Alkaline	55	22·2	10·5	1·1	—	7·7	—	O. Henry.
Chateldon	France	Alkaline, gaseous	26	36·0	18·7	2·45	—	3·5	—	
Pougues	Loire, France	Alkaline	44	93	68·0	1·4	—	32	—	O. Henry.
Royat (St Victor) ...	Puy de Dôme, France	Saline, arsenated	62	70·8	45	3·9	—	11·5	—	Truchot.
Royat (Eau Cæsar) ...	Puy de Dôme, France	Alkaline, gaseous	27	48·0	27	1·7	—	8·0	—	Lefort.
Vals (Magdeleine) ...	Ardêche, France	Alkaline	509	36	47	2·0	—	35·0	1·1	O. Henry.
Vichy (Larbaud) ...	Allier, France	Alkaline, gaseous	341	16·6	13·3	1·6	—	7	21·0	O. Henry.
Vichy (Mesdames) ...	Allier, France	Alkaline, gaseous	281	42·2	29·7	1·8	—	19·5	24·8	O. Henry.

Birmensdorf ...	Switzerland	Purgative	—	0·9	2·2	70·0	—	2,130·0	32·0	Bolley.
St. Moritz ...	Switzerland	Alkaline	20	89·8	16·8	3·1	—	26·0	—	Planta.
Tarasp...	Switzerland	Saline, iodized	272	124·3	50·0	1·5	—	195·0	294·0	Planta.
Spa	Belgium	Alkaline, gaseous	7	7·7	7·0	8·3	—	—	—	Acad. de Med.
Fachingen	Germany	Alkaline	280·0	28·0	22·0	1·1	—	—	46	Fresenius.
Homburg (Elizabeth)	Germany	Saline	—	110·0	20·0	4·6	—	3·8	868·0	Liebig.
Kissingen (Rakoczy)...	Bavaria	Saline and manganese	—	74	1·1	2·2	—	—	518	Liebig.
Kissingen (Pandur) ...	Bavaria	Saline and manganese	—	71	3·1	1·9	—	—	482	Liebig.
Levico (strong) ...	Tyrol	Arsenical	—	—	—	—	270·7	99·0	—	Barth.
Marienbad	Bohemia	Aperient	123	66	53·0	4·8	—	362·0	111	Kersten.
Orezza...	Corsica	Alkaline	—	42·0	5·1	8·9	—	1·5	—	Poggiale.
Pyrmont	Waldeck	Manganese	—	104	1·7	5·7	—	130·0	—	Wiggers.
Roman Spa	Ober-Hessen	Acid, gaseous	—	56·3	105·8	3·0	—	9·6	134	Fresenius.
Schwalbach	Nassau	Manganese	1·2	13·6	13·0	5·1	—	0·9	0·4	Fresenius.
Wilhelmsquelle ...	Nassau	Alkaline, gaseous	3·5	29·2	6·7	2·1	—	1·6	120·0	Fresenius.
(b) *American :*										
Cresson's Spring ...	Cambria Co., Pa.	Alum, 21	—	—	—	3·7	100·0	70·0	—	
Churchill Spring ...	Virginia	Alum, 72	—	—	—	—	158·2	180·0	46·0	
Sharon Spring ...	Schoharie, N.Y.	Sulphur	—	—	—	—	24·0	63·1	—	
Schuyler Spring ...	Schuyler, Ill.	Chalybeate	—	—	—	—	69·9	87·0	—	
Almaden Vichy Spring	Santa Clara, Cal.	Alkaline	201	74·0	—	5·0	—	33·0	—	
Adirondack Spring ...	Whitehall, N.Y.	—	—	—	—	4·0	—	—	—	
Oja Caliente Spring ...	New Mexico	—	—	—	—	6·0	—	—	—	

therapeutic effect; they are powerful solvents, useful to remove the waste tissues from the body in gouty and rheumatic conditions, in diseases of the liver, kidneys, and bladder. Being highly charged with carbonic acid, their bright and sparkling appearance tempts the patient to use them in large quantity without effort. They are useful whenever an alkali is indicated; they are agreeable in feverish conditions, and act as a sedative to the gastric mucous membrane in indigestion, acidity, waterbrash, and all irritable conditions, and when taken cold in sips they relieve nausea, check vomiting, and assist in retaining milk.

Carbonic acid gaseous waters in the United States are derived from the Bladon Springs, Chactaw, Alabama; the Blue Lick, Kentucky; Clarendon, Rutland County, Vermont; the Sweet Chalybeate, Alleghany, Virginia; Adam's Spring, Lake County, California; the Saratoga-Vichy, New York; and the Wilhoit Springs, Oregon. Gaseous table waters are also derived from the German springs at Belthal, Salmis-Gertrudis, Soden, and Kronthal; and the French springs at Condillac, Evian, and Renaisson; and other alkaline waters suitable for table use are those of Bilin (*Bohemia*), Schwalheim (*Nassau*), Perrier and Morny-Chateauneuf (*France*).

THE ALKALINE WATERS.

The Vals and Vichy waters may be taken as typical examples of this class. They owe their alkalinity to a preponderance of sodium carbonate and bicarbonate, and, in a lesser degree, to the carbonates of magnesium, lithium, or calcium. Some of the waters are highly charged with carbonic acid gas, which makes them bright, palatable, sparkling, or even effervescent; others have an abundance of chloride of sodium, or salts of lime or iron, which makes them of special value in certain cases, or are discharged from the earth at various degrees of heat, which renders them of further value for baths.

Vals, Vichy, and other waters in which sodium carbonate is high in proportion to the other salts are good representatives of the alkaline waters, and are indicated in certain cases of ill-health. In the cure of gout, for instance, the alkaline treatment is in the forefront; these waters so dilute the liquid in the tissues as to prevent the formation of gouty deposit, and they are

capable of dissolving uric acid. When uric acid is formed in excess, as the result of metabolic irregularity, or if it accumulates in the system owing to impairment of the functions of the kidneys or any other causes, these waters are a proper means of eliminating the same. A liberal administration of an alkaline water not only dilutes the tissues, therefore, but acts as a solvent and as a regulator of metabolism. The accumulation of the alkali in the system by the consumption of such waters need not be feared, for their ready assimilation and their effect upon the kidneys insures the speedy elimination of the salts. In diabetes the alkalies are of especial value by retarding the transformation of glycogen into sugar by the liver (Liebriech); even when the disease is of pancreatic origin alkaline treatment is still indicated to keep down excessive sugar formation and prevent the harmful results of such metabolic waste. The alkaline mineral waters have long been regarded as specifics for chronic catarrh of the stomach and bowels; they are of great value by dissolving the masses of adherent mucus, accelerating and aiding the digestion and assimilation of food by checking fermentation and assisting peristalsis; they are a rational remedy in cases of hyperchlorhydria, and any disease with waterbrash, acidity or hyperacidity of the stomach. In gastric ulcer likewise they neutralize excessive acidity and diminish its irritating action upon the gastric mucous membrane, and, by inducing contraction of the muscles and bloodvessels, diminish the possibility of hæmorrhage. They are widely used in diseases of the liver, especially chronic congestion, and for the prevention or cure of gall-stones, where, by increasing the secretion and diluting the bile, many small gall-stones are dissolved or washed away. In the treatment of diseases of the urinary organs they are valuable by the diuretic action of the alkalies, which prevent the urine from becoming concentrated, depositing uric acid or its compounds, and irritating the mucous membrane of the urinary passages. On the other hand, they promote a free flow of dilute urine; they stimulate the muscles of the bladder, and prevent stagnation and decomposition of the urine. In many cases of albuminuria they effect a reduction in the amount of albumin which is lost, and exert a beneficial influence upon the injured kidneys. In urinary gravel—a sign of retarded metabolism—the alkaline waters have a characteristic

effect ; the reaction of the urine becomes less marked, the deposition of uric acid ceases, and the urine becomes clear, bland, and unirritating. Summed up, we find that *all alkaline waters* have a diuretic effect, which renders them of value in Bright's disease, stone in the kidney, gravel, gout and rheumatic conditions, and all indications of the uric acid diathesis. They are useful in diabetes by reducing the sugar in the urine ; they increase the secretion of bile and make it thin, and are therefore of value in acute or chronic congestion of the liver, jaundice, catarrhal inflammation of the bile-ducts, and gall-stones ; they are equally useful in gastric catarrh, hyperacidity and ulcer of the stomach ; in chronic bronchitis and bronchiectasis ; in diseases of other mucous membranes, as chronic uterine catarrh, leucorrhœa, and other diseases of females ; in nervous diseases, debility, and convalescence from acute illness.

When **lithia** forms an important constituent of such waters, as in the Bonifacius, Bilin, Pitkeathly, Saratoga, and Buffalo lithia waters, they have similar anti-acid properties to other alkaline waters, and are useful in most of the diseases already named ; but they are powerfully diuretic, and are marvellous solvents of uric acid and its congeners, so that the urine of a person taking lithia waters will hold in solution a larger amount of these substances than normal urine, which renders such waters of high value and justly esteemed as a remedy for gout, rheumatic gout, chronic rheumatism, muscular rheumatism, sciatica, uric acid gravel, renal calculus, and all indications of the uric acid diathesis.

When lime or **calcium** salts are in high proportion, as in the Bath, Buxton, Contrexéville, Saratoga, Buffalo, Bethesda, Bonifacius, St. Louis, St. Galmier, Wildungen, Tarasp, and Taunus Springs, it is likewise claimed that the waters have remarkable diuretic and solvent powers over all calculi, gouty, rheumatic, uric acid, and other concretions and accumulations, wherever they may be ; indeed, they rival the lithia waters in the treatment of the same diseases.

The drinking and bathing 'cures' at the various spas occupy from three to four weeks. As a rule, the water is taken in the morning on an empty stomach ; again after breakfast, when it is followed by walking exercise ; and usually one or two glasses in the afternoon. The course of baths is taken concurrently

with the drinking 'cure'; they are sometimes taken immediately after getting up in the morning, but more often in the course of the day; they consist of ordinary baths, at various temperatures, of douches, sprays, douche-massage, steam and electric baths.

There are many other good alkaline waters besides those in Table III. which are much esteemed and of great value. Such are the Alet, Evian, Renaisson, and Morny-Chateauneuf, in France; the Salvator, in Hungary, which is **lithiated**; the Marienbad and Franzenbad waters of Bohemia, and of St. Moritz in Switzerland, which are **ferruginous**; those of Belthal, Lippspring, and Neuenahr, in Germany, which are **gaseous**; and Pitkeathly, in Scotland, which contains about 5 grains of carbonate of lithia in a pint.

In the United States of America are the following additional alkaline waters: In *Pennsylvania*, the Black Barren and Rock Springs, in Lancaster County; Strummel's Lithia Spring, Adam's County; Cressons' Springs, Cambria County; Minnequa, Bradford County; McVittey's Satilla, in Huntingdon County; the Fayette limestone and chalybeate springs, in Bedford County. In *New York State* the Cherry Hill and Valley Springs, Ostego County; Florida Spring, Montgomery; and Lebanon Spring at Columbia. *Vermont* has the Missiquoi at Frankland; *Maryland*, the Clymnera on the Manor estate; *New Jersey*, the artesian wells at Winslow, and Calo Springs at Brown's Mills; *Maine* has Underwood, Poland, and the North Port mineral wells; *New Hampshire* has the Concord, Birchdale, and Jerusalem Springs; *Michigan* has Warner's Springs at Albion, Leslie's at Ingham, and Hubbardstone's Well at Iona; *Illinois* has the Versailles Spring in Brown County, and Perry Springs in Pike County; *Ohio* has the Yellow Springs in Green County; *Indiana* has the Dewdrop and Daggy Springs in Greencastle, Hawkins' in Wayne County, Epsom in Wyandotte, and the Marian Artesian Well in Grant County; *Arkansas* has the celebrated hot springs; *California*, the sulphur springs of St. Barbara and St. Helens; *Virginia* has the Augusta, Berkeley, Capon, Healing, Jordan, Massanatten, Orkneys, Rawley, Stribbeling's, and other valuable springs; *Carolina* has Thomsons', Nicholls', Glen Alpine, Ashley's, Onslow alum and Plummer's arsenic springs; *Kentucky* has Bryant's, Howard's, the

Grove, and Field Springs in Lincoln County, besides the stone-sulphur and the Estill chalybeate and sulphur springs. Indeed, alkaline waters form the most numerous mineral waters, and are spread over almost every district, being, however, nearer to each other in some countries than they are in others.

THE PURGATIVE AND BITTER WATERS.

The purgative and bitter waters depend largely for their therapeutic effect upon the sulphates of sodium and magnesium. The chloride of sodium is present in most of them, and to a large extent in some, and the carbonates of the alkalies and the alkaline earths are usually present in inverse ratio to the chlorides. They are aperient by reason of the sulphates, metabolism is encouraged by the chlorides, and the alkaline salts render them of value in many of the same diseases as are treated by the alkaline waters. They are of considerable repute as medicinal agents in the treatment of acute and chronic diseases of the stomach, jaundice, diseases of the liver, spleen, and kidneys; in lithæmia, gout, rheumatic gout, articular and abarticular rheumatism, sciatica, cramp; in lead and other forms of poisoning; anæmia, chlorosis, diseases of the blood and skin; in scrofula, lymphatic and other enlargements; in chronic uterine catarrh, leucorrhœa, congestion or chronic inflammatory diseases of the uterine appendages, and other debilitated states of females; also for plethora, obesity, uric acid troubles, gravel, gall-stones, and troubles arising from luxurious living.

The dose of the stronger aperient waters required to produce a free evacuation is about a wineglassful, which is best taken before breakfast, and followed by a cupful of hot tea, coffee, or milk; these are the Arabella, Apenta, Condal, Hunyadi, Pullna, Rubinat, and Victoria-Offener; the bitterness may be covered by the addition of fruit juice, wine, milk, or coffee. About a quarter of a pint, half a tumblerful or more, is required of Æsculap, Birmensdorf, Franz-Josef, or Friedrichshall water to produce an equivalent effect. The aperient action of the Carlsbad and Marienbad waters is by no means the only important one; indeed, their action in that respect is comparatively little, so that a pint or two may be consumed in a day without excessive purgation, in con-

sequence of which the curative effect of other salts in them is more pronounced than in some of the stronger waters, which, on the other hand, are chiefly taken as aperients. Many other spa waters besides those in the above list have a decided aperient action, as those of Leamington, Harrogate, and Pitkeathly in Great Britain, Seidlitz and Saidschutz in Bohemia, and Leyrac in France.

The Carlsbad thermal waters may be taken as a good example of the waters containing the aperient sulphates in combination with sodium chloride and carbonate, which may be called alkaline-sulphate waters. Their action is influenced by the temperature at which they are taken, the water from the cooler springs being more diuretic, that of the hotter more purgative in effect. The sulphates act on the peristaltic movements of the bowels, liquefy the contents, and stimulate defæcation, excessive purgation being regulated by the temperature and admixture of the alkaline salts. Metabolism is especially stimulated by the sulphate of soda, which causes an increased consumption of fat and thereby reduces obesity. Such waters act very beneficially on the kidneys, especially those from the cooler springs, which are charged with a large percentage of carbonic acid gas ; for this purpose the waters of cooler origin are to be preferred. All those waters which contain a fair proportion of alkali check hyperacidity of the stomach and are useful in acid dyspepsia and chronic gastric catarrh. In chronic catarrh of the bowels and habitual constipation waters from cool springs are to be preferred to those from hot springs ; they give the best results by relieving the disturbed venous circulation and stimulating peristalsis, while they do not purge too much. Water from the hot springs, on the other hand, is to be preferred when the bowels are irritable or hypersensitive, as in chronic diarrhœa, membranous colitis, etc. ; they purge more, but have a soothing effect (Dr. Mayer). Affections of the liver are usually greatly benefited by them, especially chronic congestion and such troubles as are incurred by an opulent sedentary life and by alcoholism ; in cirrhosis of the liver they are not held to have any specific effect upon the morbid process, but they are of value by relieving its consequences, such as gastro-enteric catarrh, portal congestion, and hæmorrhoids. Very favourable results are obtained in the treatment of gall-stones by the thermal waters ;

they act on the circulation of blood in the liver, improve catarrhal and inflammatory changes in the gall-bladder and bile-ducts, dilute the bile and increase its secretion ; they improve the tone of the muscular tissues of the bile-ducts, and thereby assist in the expulsion of the stones. When not too large or impacted, gall-stones are often dislodged and discharged into the bowels during a course of the waters. Stone in the kidney, uric acid and urate stones, yield to the alkaline-sulphate waters; small concretions are washed away by the increased flow of water, others are gradually dissolved, and catarrhal conditions of the pelvis of the kidneys and bladder are likewise cured. In like manner, other troubles connected with uric acid concretions and deposits, as gout and lithæmia, are cured. A considerable reduction of weight is effected by the consumption of these waters by the obese and corpulent, especially when such conditions are due to or accompanied by congestion of the liver, fatty liver, and uric acid troubles. The alkaline-sulphate waters are beneficial in diabetes, a diminution of sugar in the urine and increased tolerance of carbohydrate food taking place in many cases during a course of them ; they are especially valuable in mild cases which are complicated by obesity or a weak and fatty heart.

Contraindications. — Certain cases should not be sent to a watering-place, as patients with cancer of the stomach, liver, or bowels ; severe dilatation of the stomach, or marked hypochlorhydria ; also cases of Bright's disease in which an appreciable degree of hypertrophy of the heart or signs of cardiac insufficiency have appeared, as to overburden the circulation by an excess of fluid of any kind would be injurious. Wherever there is marked degeneration of bloodvessels one should also be careful to restrict the quantity of mineral water consumed, and to prescribe the water from hot springs which are deficient in carbonic acid gas, which should be cooled down before being drunk. Nor should severe cases of diabetes, accompanied by rapid wasting, be sent; nor cases of advanced tuberculosis, albuminuria with marked anæmia, and lardaceous disease of the kidneys.

SALINE AND BRINE WATERS.

All waters containing a high percentage of chlorides are valuable as alteratives, restoratives, and resolvents; they act by increasing and improving metabolism, whereby the general health is improved, to the relief of special symptoms. They have a large field for employment in the treatment of scrofulous or tuberculous diseases of the skin, glands, bones, and joints; for the wasting diseases of children; for catarrhal diseases which may develop in any tissue or organ owing to the scrofulous diathesis, as chronic catarrh and discharges from the ears and nose, adenoids, enlarged tonsils, or laryngitis. They are valuable for diseases due to obstruction of the portal circulation, as chronic congestion of the liver, catarrh of the stomach and bowels, hæmorrhoids; for chronic pelvic inflammation, chronic inflammation of the uterus and its appendages, uterine catarrh; chronic peritonitis; and old-standing pleurisy. They are valuable for gout, gouty rheumatism, whether of the joints or elsewhere, and for diseases dependent upon defective metabolism, as uric acid, gravel, stone, and obesity; for various forms of blood-poisoning, as from lead, mercury, or syphilis; for chronic skin diseases; for various nervous affections, as neuralgia, neurasthenia, chorea, paralysis, sciatica; and some of the waters, as those of Nauheim, for disease of the heart. They owe their effect very largely, but not altogether, to the chloride of sodium, for it is a well-known fact that artificial solutions do not produce equally good results. The natural waters are combinations of chlorides of the alkaline earths; but some of them contain large proportions of iodine and bromine; lithium, strontium, or iron exist in others. When the chlorides are taken into the stomach they assist in the digestion of albumin and starch, and favour a free and healthy secretion by the mucous lining of the alimentary canal; they are quickly absorbed, supply the blood with some of its most important constituents, and are carried by it to all the secreting organs and tissues. They are serviceable, as stated, in certain forms of dyspepsia with defective secretion, in sluggishness of the liver and bowels, and they assist in the resolution of many chronic inflammatory exudations. The waters which are well *aerated* are preferable for drinking, such as those of Aix-la-Chapelle, Bonifacius, Homburg, Johannisbrunnen, Kissingen,

Nauheim, Roman Spa, and Taunus in Europe; and the Albany Artesian, the Mount Clemens (Michigan), Ballstone Dentonian, the Lansing, and the Saratoga-Hathorn Springs in the United States of America. They nearly all have a mild purgative and diuretic effect, the former being most marked when the thermal waters are taken, and the latter when those from cool springs are drunk. Besides their internal use, most of the waters are used for baths, inhalations, sprays, and douches.

Robin* sums up the conditions in which brine baths are serviceable: (*a*) All morbid conditions in which there is diminished nitrogenous excretion or a diminution of nitrogenous exchange in the system; (*b*) lessening of nitrogenous oxidation; (*c*) waste of those tissues which are rich in nitrogen and phosphorus. The baths act differently according to their strength: three-quarter strength baths are the most useful when it is not desired to increase nitrogenous exchange or oxidation, as in persons who are getting thin, or have a tendency to excrete an excess of uric acid; but this strength of bath will have little effect on chronic affections of the bones; half-strength baths are applicable where there is diminished nitrogenous exchange, and are useful in glandular affections, strumous disease, and affections of bones and joints. Full-strength baths have a powerful effect on organic changes; they favour assimilation, but diminish the nitrogenous output; they are useful for rickets and other affections of the bones, anæmia, and certain nervous affections, and for auto-intoxications. They diminish the production of urea, but cause the oxidation of imperfectly burned and toxic residues which poison the system, and are therefore useful for gouty conditions, obesity, etc. It has been doubted whether any greater beneficial effect is derived from bathing in waters which contain mineral salts than may be derived from bathing in ordinary water; but the experience of many years is in favour of them, and it has been shown that fine crystals of these salts are deposited upon the skin and continue to exercise their influence after the bath; and Gallad † has shown that the skin of men and animals can absorb watery solutions of these minerals.

The baths at most of the health resorts are under the super-

* *Bull. de l'Acad. de Méd.*, 1891, xxi.

† *Compt. Rendus*, 1900, 130.

vision of a medical attendant, who controls the temperature, density, and duration of the baths for each patient. The course of baths occupies three or four weeks or longer, according to the nature of the case, and is combined with massage or douche-massage in gout, rheumatism, contraction of muscles or tendons, and stiffness of the joints. Nasal or pharyngeal irrigation is used for diseases of those parts, and vaginal irrigation in female diseases. Inhalations of the water, or of concentrated water, are of great value in all affections of the respiratory organs from the nose downwards. The water is inhaled from a jet-atomizer, or by the patient sitting or taking exercise in a special apartment into which the pulverized water is driven and diffused through the atmosphere.

Special characters are attached to some of the waters whereby they attain particular effects—*e.g.*, the Bonifacius water contains 15 grains of lithia per gallon, to which its efficacy is chiefly due in the cure of gout, rheumatism, uric acid troubles, and especially gravel and stone; gall-stones are likewise eliminated by it, and it is beneficial in diabetes and albuminuria. La Bourboule water contains 1·99 grains per gallon of arseniate of soda, which makes it a natural form of arsenical treatment of great value in cachexias of all sorts, chlorosis, anæmia, scrofula, skin diseases, albuminuria, diabetes, and Bright's disease. The Kissingen water contains 41 grains per gallon of manganese salts, and is useful in cases of atonic dyspepsia, excessive mucous secretion, weakness from exhausting diseases and advancing age. The Tarasp water contains 15 grains per gallon of iodide of soda, which makes it valuable to reduce obesity and for other diseases in which iodide is indicated. The Woodhall Spa water is rich in bromine and iodine, and is of remarkable value in chronic rheumatism, gout, and the diseases usually treated by brine waters. Other well-known waters belonging to this class are the **bromo-iodized waters** of Halle and Krankenheil in Bavaria, Luhatschowitz in Austria, Saxon in Switzerland, and of Alma, Michigan, and Watkin's Glen, New York, in the United States; the **sulphuretted waters** of Pitkeathly in Scotland and St. Gervais in Savoy; the **thermal waters** of Plombières, Royat, and Balaruc in Europe; and of Deschutes in Oregon, the Liberty and Wagonheel springs of Denver, and Siloam springs of Garfield in Colorado, U.S.A.; and

not less valuable are the brine waters of Droitwich in Worcestershire, England, which contain 31 per cent. of salt; the barium waters of Llangammarch in Central Wales and Boston Spa in Yorkshire, which are of great efficacy in the treatment of strumous glandular affections, rheumatism, diseases of the heart, epilepsy, and other nervous diseases.

CHALYBEATE AND FERRUGINOUS WATERS.

These waters are carbonated or sulphated iron waters; the former contain carbonate of the proto-oxide of iron, the latter sulphate of iron. Many of the American waters contain ferric or ferrous sulphate, as also do the Levico and Flitwick waters.

In addition to those in Table V., other European chalybeate waters are from springs at Auteuil, Forges, Marcols, Morny-Chateauneuf, and Passy, in France; Recoaro in Lombardy; Driburg, Griesburg, and Schwalheim, in Germany. Other American waters containing 21 to 25 grains of sulphate of iron to the gallon are the Alum Springs of Bath County, the Alum Springs of Bedford County, and the London Alum Water in Campbell County—all in Virginia; and the Kittaning Spring, Armstrong, Pennsylvania. Other American waters containing the oxide of iron are: Thorpe's Spring (40 grains), Hood's County, Texas; Congress Spring (15 grains) in Santa Clara County, California; Orien Spring (5 grains), Jackson County, Missouri; River Spring (4 grains), Este's Park, Colorado; Stryker's Spring (10 grains), Ohio; Rock Mountain Spring (14 grains), Frederick County, Virginia; Oswassee Spring (12 grains), Shiawassee, Michigan; Cresson Iron Spring (29 grains), Cambria County, Pennsylvania; and Richfield Spring (5 grains), Ostego County, New York.

The indications for the use of these waters are the same as for iron in other forms—debility, anæmia, chlorosis, and other states of the blood in which the cells are defective in quality or quantity; diseases of females, such as amenorrhœa, leucorrhœa, catarrhal and relaxed conditions of the generative organs. Those waters which also contain the sulphates of soda and magnesia, called the **purgative chalybeate waters**, are used for all those diseases which are benefited by the bitter purgative waters (*q.v.*); those

which contain **alum** give excellent results in the treatment of chronic gastric and intestinal catarrh, especially when diarrhœa is associated with them. The **alkaline chalybeates** are useful for diseases of the stomach and bowels, for diabetes, Bright's disease, stone of the kidney, gravel, and for nervous diseases such as hysteria, epilepsy, chorea. The **saline chalybeates**, such as the Homburg water, are laxative and tonic, useful in torpidity of the liver and bowels, gall-stones, portal congestion and its sequelæ, hæmorrhoids, plethora, and the general result of luxurious living. Those which contain a larger proportion of chlorides, as the Kreuznach, are valuable for scrofula, lymphatic, strumous, or tubercular diseases of glands, bones, and joints, for nervous diseases such as paralysis, and for rheumatism and gout.

SULPHUROUS WATERS.

Most of these waters are impregnated with sulphuretted hydrogen, and some contain sulphuret of sodium or potassium. They are useful in many chronic skin diseases, blood poisons, gouty and rheumatic affections, lithæmia, uric-acidæmia; nervous diseases, chorea, paralysis; glandular and scrofulous affections of children, and tuberculous diseases of bones and joints; uterine ailments, as chronic catarrh and congestive troubles, amenorrhœa, dysmenorrhœa, chlorosis, anæmia; in respiratory diseases such as bronchial catarrh and bronchiectasis. In atonic dyspepsia, catarrh of the stomach, and hepatic congestion, a water containing not less than 12 cubic inches of H_2S per gallon will stimulate secretion, increase peristalsis, and relieve portal congestion; it likewise acts upon the skin, and stimulates perspiration and glandular activity. As a bath or douche, these waters are exceedingly useful in chronic skin diseases, rheumatism, enlarged or stiffened joints, contracted tendons or muscles, and in neuralgia, sciatica, and paralysis.

The most renowned sulphuretted water in England is perhaps that of Harrogate, which is justly celebrated; and in Scotland those of Pitkeathly and Strathpeffer. Other wells are scattered over the country in outlying places, and the water is probably as good, if less known. There are numerous sources in France, as those of Allevard, Bagnères de Bigorre and de Luchon, Barèges,

Bonnes, Cauterets, Enghien, Miers, St. Boes, St. Amand, and Uriage; Aix-les-Bains, Challes, and St. Gervais, in Savoy; Kissingen in Bavaria; Aix-la-Chapelle and Wielbach in Germany.

In America there are sulphuretted waters in nearly every State. Thus, in New York there are the Sharon Spring in Schoharie; the Auburn and the Avon in Livingstone; and Longman's Well in Rochester. In Vermont the Missiquoi; in Michigan are the Alpena and the Ypsilanti Springs; in Indiana, the French Lick Spring of Orange County; in California, the Napa and Paso Robles Hot Springs; in New Mexico, the Las Vegas; in Arkansas, some of the Hot Springs of Garland County; in Virginia, the Hot Springs of Bath County, the Sulphur Springs in Monroe County, and the Buffalo Springs in Mecklenburg County; in Colorado, the Cañon and Pogassa Hot Springs; in Ohio, the Delaware Sulphur; in Oregon, the Deschutes, Wasco County; in Tennessee, the Hagers and Castilian Springs of Sumner County.

THERMAL WATERS.

The principal hot springs in the United States are in Virginia, Colorado, New Mexico, Michigan, Arkansas, Oregon, California, Idaho, Arizona, and Utah; many of them have been more particularly mentioned. Some of the springs issue from the earth in the neighbourhood of active volcanoes; their temperature is then very great, from 150° to 195° F. The European thermal waters seldom exceed 100° F., as they issue from the earth; the majority have a temperature between 60° and 80° F., as at Bath in England; and the waters of Alet, Bagnères, Balaruc, Barèges, La Bourboule, Mont Doré, Plombières, Royat, Salins-les-Bains, and Vichy in France; St. Gervais in Savoy; Teplitz in Bohemia; Jodbad Lipik in Hungary; Aix-la-Chapelle, Carlsbad, Nauheim, Schlanganbad, Soden, Wiesbaden, and Wildungen, in Germany. At all the important watering-places there are baths of the most luxurious and elaborate description, where the water of the place is used in every conceivable form for therapeutic purposes. Most of these waters have a value indicated by their constituents; but even the indifferent thermal waters, as that of Wildbad in the Black Forest, have great curative powers in cases of gout and rheumatism in the joints and elsewhere; in nervous

disorders, as neurasthenia, sciatica, paralysis; spinal disorders, chronic diseases of bones and joints, and contraction of tendons and muscles. The treatment is aided by change of climate, proper dieting, and by drinking the water, also by electro-therapeutics, massage, Swedish and other gymnastic movements.

At some of the health resorts **mud baths** are used by mixing well-seasoned earth, containing more or less of the mineral matters which make the water of medicinal value, with warm water to a mushy state. A **moor bath** is the earth from moors used in the same way; **bog baths** consist of bog earth, produced by the decomposition of vegetable matter, mixed with the water from iron and sulphur springs; and a **slime bath** consists of the mud from the bottom of a pond or river, which is smeared over the body before washing. Each of these is supposed to accentuate the action of the water in certain cases. Mud baths are useful for chronic rheumatism, gout, sciatica, neuralgia, various diseases of women, and some skin diseases, such as moist eczema and psoriasis; they are contraindicated in valvular disease of the heart, chronic Bright's disease, neurasthenia, old age, pregnancy, and a tendency to hæmoptysis. **Carbonic acid baths** are indicated for nervous diseases, diseases of the generative organs, amenorrhœa, dysmenorrhœa, and impotence; but they are contraindicated when there is a tendency to bleeding, as in menorrhagia, chronic heart disease, disease of the lungs, and irritability of the respiratory passages. A course of baths causes a kind of eczema in some people, which the hydropathists call a 'critical eruption,' and is frequently regarded as a sign that benefit will result; it is not usually serious, and soon subsides. A similar eruption may follow the use of cold compresses, douching, or frequent bathing of local parts.

The season at most European resorts is from May until the middle of October, although the waters and baths can be had all the year.

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CHAPTER XIX

THE AIR AND CLIMATE

Air is food, and cannot be done without any more than water or bread and meat, and it is as important to have pure air as pure water or unadulterated milk, or meat free from disease, or bread and flour of proper quality.

The air or atmosphere is the gaseous envelope which surrounds the globe to a height of about forty miles, and exerts a pressure at the sea-level of 15 pounds, or 760 milligrammes of mercury upon every square inch of surface. Its composition, which has been ascertained to be fairly constant up to a height of 14,000 feet, is as follows : Oxygen 21 volumes and nitrogen 79 volumes per cent., together with 4 volumes of carbonic anhydride in 10,000 and a trace of ammonia.

The air is our source of oxygen ; a man consumes about 300 cubic centimetres of oxygen per day for every kilo (2·2 pounds) of body-weight : this, however, varies according to the work done and some other things ; and he absorbs through his lungs about 750 grammes per diem, and exhales about 900 grammes of carbonic anhydride during the same period. By the law of diffusion of gases, the air in his lungs surrenders oxygen to the blood, and the blood gives up carbonic acid to the air until an equilibrium is established, against which equilibrium respiration is constantly acting. Some of the oxygen is in solution in the blood, but most of it is in chemical union with the hæmoglobin ; the tour which oxygen makes is from air in the lungs to the blood, from blood to the lymph in the tissue spaces, thence to the cells, where it is used in the oxidation of various chemical compounds, and much of it ultimately leaves the body as carbonic acid gas. The carbonic acid gas passes from the cells to the lymph, thence to the blood, and is surrendered by the blood to the air in the lungs, diffusion taking place all along the path ; but in the blood the carbonic acid gas is partly dissolved in the serum, and is partly in loose chemical union with the salts in that liquid, forming acid sodium carbonate and acid sodium phosphate.

The air which leaves the lungs, having been actually breathed

once, shows marked changes; the oxygen in it is diminished to 16 volumes per cent., and the carbonic acid increased to 430 per 10,000 volumes, and a little ammonia and marsh gas added to it; moreover, it is slightly increased in bulk, is moist from the addition of watery vapour, and may have a slight odour. These changes are important in connection with the ventilation of rooms and buildings. The diminution of oxygen in the air of a room owing to absence of ventilation is not great, nor would such diminution be so bad if we could be sure that no deleterious gas or substance took the place of the oxygen, for it has been found possible to live for some time in an atmosphere containing only 4 per cent. of oxygen when the air was free from impurities. The two following tables show the percentage of oxygen and carbonic acid in the atmosphere at various places:

The Percentage of Oxygen in Air.[1]

Analysis of the atmosphere by Humboldt and Gay Lussac (mean)	21·00
On mountains and large plains (Gay Lussac)	21·49
On the Baltic Sea (Vogel)	21·59
Scotland, on the sea-shore (Angus Smith)	20·99
,, on hill-tops (Angus Smith)	20·98
Manchester (Angus Smith)	20·95
London, in open spaces (Angus Smith)	20·95
,, in a workhouse (Angus Smith)	20·88
,, in a sitting-room (Angus Smith)	20·98
,, in the pit of a theatre (Angus Smith)	20·74

The Amount of Carbonic Acid Gas in 10,000 Volumes of Air.[2]

(From Analyses by Roscoe, Pettenkofer, Frankland and Angus Smith.)

Scotland, on hill-tops	3·32	volumes.
,, on the sea-shore	3·41	,,
Mont Blanc (top)	6·10	,,
Chamonix (top)	6·30	,,
On Lake Geneva	4·39	,,
At Madrid	5·00	,,
At Munich	5·00	,,
At Manchester	4·00	,,
,, in a fog	6·70	,,
,, in a theatre	33·00	,,
,, in a workshop	30·00	,,
In mines	78·85	,,
In a London barracks	12·42	,,
In a Chatham barracks	19·50	,,
In a Chatham hospital	18·00	,,
In a boys' school	23·70	,,
In a boys' school at Munich (Pettenkofer)	70·00	,,
In a crowded meeting	35·50	,,

Air seldom loses more than 1 per cent. of oxygen under *ordinary* circumstances, though the carbonic acid may rise to 70 in 10,000 volumes, and both are prejudicial to health. Air is, therefore, rendered impure less by the removal of oxygen than by the addition of carbonic acid gas or other gases and animal products. The presence of foul air in a room may be determined by the sense of smell, and by consideration of the means of ventilation and cubical capacity of the room for the number of occupants. Roughly speaking, a space of 1,000 cubic feet for each individual is necessary to maintain the purity of the air in a room, with the ordinary ventilation by means of a door and chimney and the chinks around the windows. The necessity for ventilation is apparent, and is required as much for the removal of carbonic acid and other foul gases as for the renewal of oxygen; for wherever people are crowded together or the space is confined, the oxygen becomes exhausted and carbonic acid takes its place, and the lungs and skin give off waste organic materials which give to the air a peculiarly unpleasant and penetrating odour.

The carbonic acid gas in ordinary air is about 4 parts in 10,000, but in a room full of people it reaches 20 or 30, and as much as 70 parts in 10,000 have been observed. Now, an atmosphere containing 19 parts of carbonic acid gas in 10,000 (without excess of organic impurity) feels fresh and agreeable and cannot readily be distinguished by smell from pure air, and as much as 40 parts in 10,000 is not very evident to the senses, though in both cases it has a bad effect upon vitality; indeed, *the sensible discomfort of bad air is largely due to the organic matter in it.* When the amount of carbonic acid gas in the air rises to 30 or 40 in 10,000, it excites more rapid and difficult breathing; and should it reach 20 per cent. (500 in 10,000), as it ultimately must do by breathing in a confined space with no ventilation, the carbonic acid acts as a narcotic poison and causes death. In such an instance, as the confinement of prisoners in the Black Hole at Calcutta, asphyxia would be induced by the diminution of oxygen and accumulation of carbonic acid gas, and death would result from the action of the carbonic acid rather than the loss of oxygen, because the persons would be poisoned before all the oxygen could be used up.

The chemical compounds found in the impure air of a close

room are animal products, which can be estimated by the amount of organic nitrogen, increased carbonic acid, and diminished oxygen. The nitrogenous products can be shown to be present by shaking up a solution of permanganate of potassium in a bottle containing the air, when the colour will be removed. Ammonia is almost universally present in the air, but particularly in that of a crowded room or in the neighbourhood of decomposing animal or vegetable matter; it is recognised by two tests: free ammonia by Nessler's test, and organic or albuminoid ammonia by Wanklyn's method, used as in testing an impure water. The determination of the diminution of oxygen is not so readily performed, but it can be inferred from the amount of carbonic acid in it, the presence of the latter proving a diminution of oxygen. Carbonic acid can at once be shown to be present by agitating the air in a bottle with lime-water or baryta-water when the solution becomes cloudy, and the quantity of carbonic acid is ascertained by collecting and weighing the deposit.

Sewer gas acts very injuriously when it contaminates air or water. It is generally perceptible to the smell, and its presence in a house arises usually from defects in the water-closet or waste-water pipe or kitchen sink; it may also arise from a broken drain, especially a drain going under a floor or any portion of the building. The gases vary, but they usually consist of sulphuretted hydrogen, carburetted hydrogen, sulphide of ammonia, nitrogen, oxygen, carbonic oxide and anhydride, ammonia, and certain fœtid gases allied to the compound ammonias. It is quite possible for the inodorous carbonic oxide, which is very poisonous, to pervade inhabited places in a proportion far beyond foul gas and escape detection, yet be more dangerous because its presence is imperceptible.

VENTILATION.

The public have now a more intelligent appreciation of pure air and its necessity for the maintenance of health than formerly. Health is only possible when to other conditions is added a supply of pure air, and statistics have proved beyond a doubt that impure air is one of the most potent factors in the causation of phthisis and many conditions of ill-health. The air in a room occupied by people lacks freshness after a time, and a feeling of

lassitude and heaviness affects the occupants when the ventilation is defective, and such air has been proved to contain a poisonous principle which is far more deleterious than carbonic acid gas.

In determining a proper mode of ventilation several points require consideration. The density of the air which leaves the lungs in expiration is the same as that of air which has been warmed to 78° or 81° F.; it is therefore lighter, and naturally rises when the temperature of the surrounding air is below that range, and falls when it is above it. As the air in the lungs acquires so much heat as to be specifically lighter than the surrounding air, it rises above our heads when it leaves the body, and each individual increases that effect; natural ventilation, therefore, takes place from below upward. The *exit* for spent air ought, for this reason, to be near to the ceiling—at any rate, some distance above the heads of the occupants; exits near the floor, as in low ventilation, ought to be avoided on various grounds. The *supply of air* from inlets high up is wrong in principle; pure air can never be supplied in this way, for the air is so warm when it leaves the lungs that it must perforce rise; but if the supply of new air to the room comes in from above it can only reach the occupant by cooling and bringing down with it the foul air which Nature was endeavouring to remove; consequently, there is nothing to breathe but a mixture of polluted air.[3] Again, carbonic acid gas is heavier than air, and on *a priori* grounds that which leaves the lungs ought to fall to the ground, but practically such a thing does not happen; the carbonic acid gas which leaves the lungs and skin is thoroughly diffused through the warm air rising from the body, just the same as when that gas is made by a candle or gas flame. Professor Woodbridge says that a gas which is once diffused through the air can no more sink or settle down out of it and occupy a lower stratum than salt can settle out of the sea to its bottom; carbonic acid gas in expired air must therefore rise with the current of warm air and leave the room with it.

As each person in a room is a source of warmth to the air around him, it rises above his head, and its place is supplied by cooler air; he thus assists ventilation. If, therefore, a supply of fresh air from below could have access to each person in an assembly, and the warm columns of air arising from their lungs

and skin were drawn off through the roof or near the ceiling to where they naturally ascend, and not permitted to return to be breathed over again, an ideal system of ventilation would be established;[4] such is Boyle's system of ventilation. The currents of impure air arise to the ceiling and escape, leaving the floor occupant in the cooler and purer supplies at the floor untainted by the vitiated air which arises from it. In large rooms, churches, theatres, the ideally perfect ventilation consists in encouraging such a regular up-current from a level below that of the human heads to extraction outlets in the ceiling.[5] The ventilation of small rooms, dwelling-houses, and others, may be readily performed by the Louvre and Cooper's window ventilators, by Tobin's tube, Sherringham's valve, Ellison's conical bricks, or by Arnot's or Boyle's valves consisting of talc plates.

The heating of rooms by a supply of hot air is deleterious to the health of the occupants; this is one of the great evils of the mechanical system of ventilation. When the building has to be warmed with the air-supply, the air gets burnt, it loses a portion of its oxygen, gets hotter than is either comfortable or healthy for breathing, and causes a feeling of oppression and lassitude, owing to the insufficiency and attenuation of the oxygen in such overheated and rarefied air, which is enervating and lacks freshness. All authorities agree that the heating and ventilation of a room should be dealt with separately. An American engineer attributes the premature loss of the freshness and bloom of youth by many Americans to the enervating effects of the hot-air systems of heating and ventilating which have been in vogue in the United States; these are now being discarded in favour of hot-water pipes and methods of warming by *radiant heat*, which are very much healthier.

THE CLIMATIC TREATMENT OF DISEASE.

The seasonal changes of the atmosphere and other aerial influences are factors affecting alike the sick and well. Nothing, for instance, is more certain than that a cool summer and a mild winter are attended by a proportional diminution in the death-rate, and that a severe winter or a very hot summer equally show an increase of mortality. A continuance of northerly wind will

brace and invigorate a healthy person, make him agile, fresh-coloured, quick and nimble ; but it increases pulmonary diseases, bronchitis, coughs, colds, catarrhs, rheumatism, and is especially fatal to the delicate and aged. A continuance of southerly winds relaxes the body, causes languor, heaviness, laziness, even dizziness, dulness of the senses of sight and hearing ; and when combined with continual rain or very frequent showers it favours most diseases.

The importance of *change of air* during convalescence from disease is very great ; its power of recuperation is undoubted, and has been advocated from time immemorial, while the search for a climate where the temperature and constitution of the atmosphere is better suited to an invalid than that of his ordinary place of residence has been the subject of many discussions. The great desideratum is to find a climate and sheltered residence for delicate persons during the winter and spring. But merely a place of rest and shelter from cold winds is not sufficient for all who seek change of air to restore them to health. 'There are some to whom new life comes with active exercise on the moors, or among the peaks and passes of mountains ; and others who need rest, for whom a sea-voyage or lying on a beach throwing pebbles into the sea is a desideratum. Those who need the first and choose the second return from their holiday more oppressed than ever ; those who need rest, and take violent exercise, return with a strained heart or over-distended lung. Change of work is good for some, cessation for others' (Dr. Symes Thompson).

The special feature in *seaside* treatment lies in the sea air. It is impossible to say what is the most important property—its purity, richness in oxygen or ozone, its transparency, or its high barometric pressure. The general effects, however, are increased blood formation, increased activity of metabolism, and increase of bodily energy ; and the respiratory movements are slower and deeper in proportion to the greater barometrical pressure. Sometimes, however, a change to the seaside does harm, and one should consider the comparative advantages of the ordinary residence and the place to which the patient is being sent. In this connection we should take into account the difference of the mean annual temperature of the two places, as well as the barometric pressure, chief direction of wind, the humidity of the

air, and rainfall. Foggy and rainy days are less common at most seaside resorts than inland; but sea air is generally more humid. The temperature of the air at the sea is lower than that inland at the end of winter (March and April) and in spring and summer, but it is higher in the autumn and most of the winter. The sensation of coldness is usually due to the direction of the wind, and is not a correct indication of temperature; the thermometer ought, therefore, to be closely watched. Violent wind is deleterious to many invalids, but a day or two of storm at the seaside is usually followed by many calm days; in March, April, and May, the storms are longer and more frequent. Strong wind increases the respiration and pulse, and is thereby injurious to sufferers from heart disease, Bright's disease, or consumption, and particularly injurious to tubercular patients, persons with nervous diseases, hysteria, neurasthenia, chorea and epilepsy, and convalescents from scarlet fever, diphtheria, or measles. Such persons are advised to remain inland during the early spring, or to go only to warm, moist places. Early cases and other cases of phthisis which are free from fever usually do well at the sea, although stormy weather and sudden changes of temperature are bad for them; the season and place ought therefore to be picked for them. Hay-fever is often cured by sea-air. The winter (excepting, perhaps, November and December) may be passed at the sea by sufferers from chronic bronchitis, asthma, laryngeal and nasal troubles, gout, rheumatism, rheumatic gout; tubercular diseases of bones, joints, or glands, disease of the spine, and chronic abscesses. Delicate children usually do well at seaside resorts; but such as require careful medical supervision, especially those with tubercular diseases of the lungs or abdomen and kidney troubles, should only be sent there during certain seasons and to suitable places.

The beneficial effects of a *sea voyage* of some duration are known to all, especially for patients with chest troubles and those who need recuperation without fatigue. Those whose daily work or disposition leave but little time for repose are frequently made worse by Continental travelling, with its long railway journeys and frequent change of hotel, or, again, by shooting or mountaineering; but a trip to Australia or to the Cape and back —the latter occupying about seven weeks for the return journey

—affords ample means of rest, change of air, and company. 'The sea, after a possible tumble in the Bay of Biscay, is one of almost lake-like smoothness, the temperature equal, and altogether the patient is sailing through summer seas. I have no hesitation in recommending the voyage to those who require real rest of body and true recreation of the faculties' (Lennox Browne). The sea trip will be enough for many people, but most invalids require a stay on land of some duration before making the return voyage; and in South Africa, Australia, or the West Indies are many variations of climate suited to the needs of different individuals. Dr. Robson Roose, in speaking of a sea voyage, says: 'It is good for overworked business and professional men suffering from sleeplessness, neuralgia, and similar complaints, and its effect is truly marvellous, as it gives the greatest amount of nerve restoration in the smallest space of time. Persons of delicate chest or gouty habit derive much benefit from it.' It is possible for overtired persons, who are only able to take a holiday of three weeks' duration, to obtain marked amelioration of their symptoms by a voyage and a few days' rest in the Canaries, or in the charming island of Madeira, which is highly spoken of as a place for nerve rest. A sea voyage with a short sojourn in a summer climate may accomplish more completely what is often sought in a stay at European health resorts. Nothing can be better for those who have run down from overwork, insomnia, or faulty adaptation of the human machine to its environment, for those who are unequal to active exertion or the bustle of a crowded lodging in the country or at the seaside. Change of scenery and surroundings can be found at sea as elsewhere. The melancholy patient is sure to find on board a mixed party of fellow-travellers with bright animal spirits and exuberant vitality. The fact that he cannot shut himself from society keeps him from *ennui*; he will soon be drawn out of himself, and the change effected in a few weeks will be marvellous.

HEALTH RESORTS IN GREAT BRITAIN.

The warmest winter residences in England are generally found in the south; here the blessings of warmth, sunshine, and a mild climate in the winter months may be found without crossing

either the Channel or the Continent, or increasing the toil and expense of a sojourn in the Riviera or more distant climes. We have places in our land which, if they do not rival the foreign ones in extent, are considered to do so by their mildness and salubrity. Our southern coast has a superior climate, well adapted for invalids in December, January, and February; but in March the temperature begins to approximate more nearly to that of the interior, and in April and May the temperature of the interior gradually gets higher than that of the coast, and continues to rise, though in a less ratio, throughout the summer; in October they are about equal, but in November the temperature of the coast again begins to exceed that of the interior.

The coast of Cornwall has a peculiar climate, which depends on its almost peninsular situation. There is a remarkable equability of the temperature throughout the year, both day and night, which in some respects is said to make it superior to Southern Europe, the only place that excels it being Madeira. Falmouth and Penzance are about the best-known places, but there are many quiet spots about the Lizard, Land's End, and the adjacent Scilly Isles, which are equally delightful. Mullion, for instance, about five miles from the Lizard, in Mount's Bay, provides a shelter from the east winds of an English spring; it has an exceptionally mild climate, softened by the Gulf Stream, and a maximum of sunshine, and provides abundance of material for the botanist, geologist, and ornithologist, as well as fishing, golfing, boating, cycling, and driving. Coming to particulars, Penzance is about $6\frac{1}{2}°$ warmer than London in the night and only 3° warmer in the day; it is mild and equable, but somewhat damper and more rainy than Falmouth. The softness and humidity of the atmosphere in Cornwall, joined with the mild and equable temperature, render it beneficial for all pulmonary diseases and for people with morbid states of the mucous membranes, but it is less suitable for those with relaxed or nervous constitutions. Unfortunately, gales are frequent on the coast, and the rainfall is nearly double that of London; and Penzance, owing to its want of shelter from northerly and easterly winds, is colder than Torquay during spring. The late Mr. Whiteley, in writing of South-West Cornwall, said: 'A Canadian would think there was no summer and say there was no winter. The month of

January at Penzance is as warm as at Madrid, Florence, and Constantinople, and July there is as cool as St. Petersburg in the same month. . . . There is no country in the world with a climate so mild and equable as that of the South-West of England, if we exclude the South-West of Ireland, where this peculiarity is intensified. The cause is well understood. The Atlantic Ocean on the west is an immense reservoir of warm water, fed and heated by the Gulf Stream, so that around the Cornish land in the depth of winter the temperature is seldom below 46° F., and out at sea the water is much warmer. The almost insular position of Cornwall, its narrow area, and the warm sea, give it generally a climate of singular equability.

The following table, showing a comparison of the mean temperature and its greatest daily range at the places named, is taken, with acknowledgment, from 'Cornwall as a Health Resort,' by E. Kitto, F.R.Met.Soc.:

THE MEAN TEMPERATURE.

Place.	Latitude.	Degrees Fahrenheit.						
		Nov.	Dec.	Jan.	Feb.	March.	April.	Daily Range.
Falmouth ...	59° 9′	47·5	44·4	43·2	43·5	43·9	47·4	4·3
Penzance ...	50° 7′	46·8	43·5	42·2	42·8	43·6	48·4	6·2
Scilly Isles ...	49° 55′	49·9	47·1	46·0	46·0	45·8	48·7	4·1
Mentone ...	43° 45′	54·0	49·1	48·7	49·1	52·8	58·3	9·6
Nice	43° 41′	52·0	46·9	45·4	46·5	50·9	57·1	11·7
Montpellier ...	43° 36′	50·0	44·0	43·3	47·0	50·2	55·6	12·3
Cannes ...	43° 32′	52·9	46·1	48·0	48·8	51·0	55·5	9·2
Pau	43° 19′	47·0	42·8	41·2	43·6	48·8	51·8	10·6
Madeira ...	32° 40′	65·8	63·2	60·4	61·4	62·3	64·0	5·4

A glance at the above table shows that the winter climate of Cornwall rivals that of the chief foreign health resorts in mildness and equability of temperature, and justifies the name of Cornish Riviera, in comparison with its foreign rivals on the shores of the Mediterranean and amid the waves of the Atlantic. Madeira and Teneriffe alone are more favoured than Cornwall in the daily range of temperature; and, as regards cold, there are winters in which a frost is unknown, and ice enough to skate upon is a tradition rather than an experience. Falmouth is

especially favoured with sunshine, and, with the exception of Jersey, it stands at the head of the list of forty-six meteorological stations in the British Isles for the ten years 1881 to 1900. Most of the winter resorts of Cornwall lie on the coast, where there are not only Falmouth and Penzance, but many sheltered villages; and not the least important matter is that they can all be reached with little cost and fatigue, and consequently at a minimum risk to the invalid.

The Scilly Isles, being in the Atlantic, but quite near the mainland, are beautifully warm and mild in the winter, have a very equable temperature, as seen from the above chart, are a few degrees warmer than the places on the Cornish coast, and in December, January, and February are about as warm as Nice and Cannes. The climate is very suitable for persons with consumption, chronic bronchitis, emphysema, asthma, Bright's disease, and other conditions which need a mild and equable climate, free from cold and dry winds. A patient, writing from St. Mary's Isle in early March, said: 'We live as if on the deck of a ship, with the Atlantic all around us. Such colour, such air, such sunshine! The sea is as blue as the Mediterranean, and we *live* out of doors, sitting on the rocks or sailing about amongst the other islands from morning to night. It is an ideal winter climate.' The luxuriant tropical flowers, which grow freely out of doors, attest its warmth and humidity; the usual garden flowers of England are grown on farms by the acre for the market. 'If people knew more about Scilly they would certainly come here instead of going to Southern France or Italy.' 'The sailing and yachting about Scilly are simply glorious and most exhilarating, and splendid for the nerves! It makes one feel as lively as a seagull, and as hungry as a shag or cormorant.' The journey is quite easy for an invalid.

The south coast of Devon has likewise been noted for its mildness, the temperature of its more sheltered spots being about 5° or 6° higher than that of London in the winter months. The places most in repute are Torquay, Dawlish, Sidmouth, Exmouth, and Salcombe.

Torquay has a natural situation which is very advantageous to it as a health resort. It occupies an almost peninsular position, and is protected on the north and east by a range of hills which

shelter and give mildness to the place. Its peninsular position and proximity to the sea, which render its climate mild and equable in winter, make it equally cool in summer. The equability of temperature is very marked, and the daily range is not great. The mean maximum temperature for ten years = 56·4°, the mean minimum = 43·9°, the daily range 11·6°. It compares favourably with some of the Cornish and Continental resorts. Compared with that of all England, the *mean* annual temperature is 2° higher, but the maximum is 7° lower, and the minimum 12° higher. All tables show a large excess of sunshine in winter at Torquay as compared with Greenwich. During four months the total hours of sunshine were 226 at Torquay, 219 at Bournemouth, 219 at Ventnor, 200 at Eastbourne, and 137 at Kew. The prevailing winds are south-west, and almost all gales blow from that quarter ; the high hills shelter it from northerly and easterly winds, and invalids are enabled to spend much more time out of doors than in many other places. The average rainfall for nine years was 35·39 inches ; days on which snow fell, 18 ; and foggy days, 39. Many times when snow falls it does not cover the ground, and ice strong enough for skating is unknown. The Torquay district consists entirely of limestone and slate, giving the place an interest to the geologist. Tropical and subtropical vegetation grows readily out of doors, and is a proof of the mildness and equability of the climate ; the plants of the English gardens bloom freely in November. During November and December people can frequently sit out of doors in a brilliant sunshine, surrounded by the odour of flowers and the warbling of birds.

The climate of the coast of Devon and Cornwall is exceedingly suitable for a winter resort for invalids, especially for those suffering from phthisis, bronchitis, and asthma, and it is very efficacious in soothing all irritable states of the respiratory and other mucous surfaces accompanied by more or less secretion and susceptible of irritation from dry winds. For the aged, who have no power to resist cold, and whose diminished vitality renders them susceptible to every change of wind and temperature ; for people with dyspepsia, kidney or uterine diseases, and various nervous troubles arising from them, this climate may be recommended as beneficial. Children of enfeebled constitution

and those born in tropical countries may advantageously live at these places, for here the difficulty of rearing them is much lessened.

All cases of illness and invalidism are not benefited by this climate, and especially such persons as suffer from passive congestions or very copious secretions; also atony of the stomach; diseases of the uterine system with excessive discharges; and, generally speaking, it is not to be expected that patients with a relaxed state of the system will greatly benefit by a sojourn in Devon or Cornwall, especially if the residence is prolonged. Such persons are more likely to be benefited by Brighton, Bournemouth, Clifton, or other place with a drier and more bracing air.

The climate of Bournemouth is very suitable for a winter residence, and in the summer it is, for the south, a delightful, cool, and bracing seaside resort. The climate is influenced by the geological formation on which the town stands, by its geographical position, and by the pine-woods which surround the district. The subsoil of Bournemouth is sand and gravel of the most porous character, over clay which lies 100 to 120 feet below the surface; the natural drainage is therefore admirable, and the surface of the soil is soon dry after the heaviest rainfall. The geographical position is said to influence the amount of cloud. Bournemouth has the sea to the south, two rivers to the east, and the Purbeck Hills to the west and north, which draw away the clouds, so that there may be a good deal of cloud around the place while there is little above it. Less cloud, of course, means more sun, and it claims to excel many other places in absolute amount of sunshine. Bournemouth escapes the fogs which hang over the swift tidal currents, because it is out of the sweep of the Channel, and when they come from the south-west they are detained by the Purbeck Hills. The pine-woods affect the climate by giving shelter without drawing damp, and they medicate the air by their balsamic exhalations. During spring, when the fresh shoots are formed, and under the influence of the sun's rays, a very large amount of terebinthinate vapour is given off.

Invalids seeking health, or overworked persons seeking rest and change, may find plenty of amusement and recreation in the town or by sea and land. For the geologist, the Portland and Purbeck beds on the coast and the famous Barton beds

on the east; for the botanist, heath and moorland and the fertile valleys of the Stour and Avon or the New Forest, afford rich fields of investigation; and for the antiquary there are a variety of objects within easy reach.

As a winter resort for phthisical patients, and all those invalids whose vitality gets lowered by confinement to the house, Bournemouth offers many advantages. They cannot quite escape an English winter there, but it is asserted that they will get the driest climate there which England has to offer, and they will thus be able to get a large amount of out-of-door exercise. The climate is dry, with a fair amount of sunshine, and the place is sheltered from all quarters but the south. It is not a relaxing climate because of its dryness, and it is suitable for some cases which do not get on in the moister atmosphere of Devon or Cornwall.

The cases which do not improve there are bronchial cases with a dry, irritable cough or viscid, scanty secretion, which require a moister and more soothing climate; many throat cases with an irritable mucous membrane also do better in a moister atmosphere than here; and some forms of neuralgia are aggravated either by the dryness of the atmosphere or the proximity to the sea.

In the Isle of Wight, Ventnor, Undercliff, and other places are suitable for pulmonary and other invalids. Ventnor has the highest winter temperature of any place in Great Britain. Undercliff is sheltered and warm, and has the advantage of being suitable for a summer residence.

Hastings and St. Leonards, being situate at the base of a range of hills, is protected in a considerable degree from north and north-east winds; it is a milder and more sheltered place during the winter and spring than any other part of the coast of Sussex.

Weymouth, a lovely seaside resort on the Dorset coast, is a well-favoured spot, with a warm, equable climate in winter, and a cool, dry, bracing air in the summer; rainfall small, sunshine brilliant; there are valuable medicinal waters of the chalybeate and sulphuretted class.

Brighton differs from Hastings and Undercliff in being exposed to northerly winds, which materially alter the climate. But if it is not suitable for persons with diseases of the chest, it is a drier and more bracing atmosphere than that of the places just named, or of the Devon and Cornish coast, and it

offers advantages to persons of a relaxed and nervous habit who are not very excitable. Autumn to the end of December is the best season, after which Bournemouth, Hastings, Undercliff, Torquay, or one of the Cornish places would be better.

The Channel Islands.—Guernsey and Jersey have a climate resembling that of the coast of Devon or Cornwall, being somewhat warmer, but more exposed to high winds. South-westerly winds prevail in the autumn and winter, north-easterly winds in the spring, and when the latter prevails for weeks together it has the same unpleasant effect on invalids as elsewhere. Jersey is the place best suited for invalids, and for the same diseases as Devon or Cornwall.

The coast of Kent presents some well-favoured spots which are very suitable for invalids. Such is Sandgate, which is at the base of the Folkestone cliffs; it is protected on the east by these high grounds, and on the north by well-wooded hills. It is a warm and sheltered spot, with a climate as balmy as that of the shores of France on the Mediterranean, and the air is charged with health-giving ozone. Folkestone has a mean temperature of 50°—maximum 55·3°, minimum 44·7°; rainfall 22·3 inches; the soil is sandy and porous.

Margate occupies an exceptional geographical position, which has made it a health resort for generations; it has the sea on nearly every side, from which it derives a wonderfully pure and strong atmosphere. 'The climate is equable, and the rigours of winter are tempered by influences ascribed to the mass of seas surrounding the promontory on which the town stands, and the aerial drift—that is, the circulation of the atmosphere in the north temperate zone—which has the gift of mildness in its flow.' The official records show that Margate, though cooler in summer, is actually warmer in winter than the suburbs of London, being ½° colder than Bournemouth and 2½° colder than Ventnor, which has the highest winter temperature of all British seaside meteorological stations. The prevailing winds are south-west, and all winds blow from the sea except a direct west wind. The sunshine record shows only 18 per cent. of sunless days. The rainfall is as low as any in the kingdom. The temperature averaged 50·9° in 1900, being 91° in the shade on the hottest and 21·6° on the coldest day; the nights are warm, there being only a range

of 12° between the day and night. The subsoil is chalk and very permeable, and the air is so dry that the rapid disappearance of the effects of a heavy shower of rain, and the general absence of dampness, are features of importance to invalids and a material factor in the healthiness of the climate. 'Nature has provided Margate with the chief features of a marine health resort: an extensive sea-board, sea breezes from nearly every quarter, abundance of radiant sunshine, a low rainfall, an equable temperature, an absence of fog, a dry subsoil, and a moderate altitude.' The climate of Margate is very highly recommended for tuberculous diseases of bones, glands, joints, diseases of the spine, and early cases of phthisis. It is beneficial in all cases of debility following acute or chronic diseases, and as a place for recruiting after influenza, or for the victims of overwork or brain-fag, and convalescence from bronchitis, pneumonia, or pleurisy.

There are many other places on *the East Coast* which are admirably suited as resorts for those who are suffering from general debility, anæmia, the scrofulous or tuberculous diseases of glands, bones, and joints, and as a restorative to those who are recovering from many forms of acute illness. Not many places on this coast north of Margate are, however, suitable for a winter resort; but Hunstanton has a westerly aspect, is dry and free from fogs, and sheltered from north and east winds.

The coast of Wales offers many delightful spots of great value to the invalid, and of equal interest to the seeker after rest or change and recreation.

Tenby may be made the headquarters or resting-place for the Pembroke coast. Pembrokeshire is especially adapted for the seeker after health. Its position at the extremity of South Wales, bordered on three sides by the sea, gives it the full advantage of the south-west winds of the Atlantic; and its climate is more humid, its winters milder, its summers more moderate, than in any other part of the Principality. Tenby claims that it can hold its own with any seaside resort in the kingdom. A grand limestone cliff forms the background, the Carmarthen Bay is before it, a wide expanse of sand is at its feet, and the delicious atmosphere charged with ozone combines to make it a delightful seaside resort. The softness and mildness of the air, the absence of frost, and the sheltered situation, render it suitable for

a winter residence. The following figures compiled from official records prove the eminently favourable climatic conditions of this watering-place: Mean temperature, average of twenty years—October to March, maximum 48·2°, minimum 41·7°, range 6·5°; April to September, maximum 58·6°, minimum 50·4°, range 8·2°. This bears favourable comparison with the records of Bournemouth, Brighton, Torquay, and other places. The pedestrian will find walks galore, the geologist and antiquarian food for reflection, the angler and sportsman abundant opportunities for trying their skill. It is suitable for the same cases as at Margate, as well as pulmonary and kidney diseases.

Penmaenmawr has the advantage of sea and mountain, and is a fine health resort, with delightful walks and drives and charming surroundings. The climate is mild and dry, and exceptionally favourable for a winter residence.

Aberystwyth has been called the 'Biarritz of Wales,' and is a delightful place with an equable temperature, its shores being swept by the Gulf Stream and the south-west breezes of the Atlantic. It was highly recommended as a place of resort for invalids by the late Dr. James Clark.

Southport, situated on the west coast, is swept by healthy, equable sea breezes, free from harshness and from great warmth. The average temperature of the year is 48·5°: January, 38·1°; February, 39·2°; March, 41·4°; April, 46·4°; May, 50·7°; June, 57·7°; July, 59·7°; August, 59·8°; September, 56·0°; October, 48·4°; November, 44·4°; December, 40·5°. The wind from October to February is southerly or south-easterly. The rainfall is about 30 inches. Snow is very infrequent. Southport is recommended for bronchitis, nervous diseases, heart disease, and all kinds of children's diseases.

The Isle of Man has a mild and equable temperature, due to the proximity of the Gulf Stream, being seldom too hot in summer or too cold in winter. Port Erin and Port St. Mary are recommended.

To mention and give figures illustrating the advantages to be derived by a residence at all the watering-places in Great Britain would fill a volume. There is no lack of places to which invalids may resort in summer, but some attention should be paid to the nature of the patient's disease and the climate. The milder and

more sheltered situations should be chosen for delicate and very sensitive invalids; while for the relaxed and enervated, and those possessing less sensibility, the high and dry latitudes, hill districts and moorlands, will be suitable. For a large class of cases the seaside watering-places with sea-bathing are the best in the latter part of the summer; for others, the inland places like Malvern, Cheltenham, Leamington, Tunbridge Wells, Clifton, Okehampton, Matlock, Buxton, Ilkley, Harrogate, where drinking the water is a part of the cure, the moors and hills of Yorkshire, Cumberland, Westmorland, and Scotland, being particularly suitable for those needing a bracing and invigorating atmosphere, and who are not too sensitive to cool breezes.

Malvern, Clifton, and **Okehampton** are more exciting, bracing, and drier than the health resorts on southern coasts, but not so mild; consequently, these places are suitable for persons of relaxed and nervous disposition or languid habit, for weakened nerves and nervous diseases, dyspeptic persons, and young people of scrofulous or strumous disposition. Okehampton may be made a centre for Dartmoor, upon which shooting, golf, and other exercises may be had, and which is in many ways interesting to the seeker after change and fresh air. The Hotwell springs of Clifton contain sulphate and carbonate of lime, and the water is valuable in the treatment of gout, rheumatism, and many other cases treated by the alkaline lime-waters (*q.v.*). This district has the advantage of beautiful scenery combined with a good climate. It is warm, genial, of equable temperature, and one of the driest places in England. The prevailing winds are south-west and west from the Bristol Channel.

Matlock is of value as a health resort for its lovely scenery and pure, invigorating breezes from the hills. The health-seeker finds many places of interest in or near Matlock which appeal alike to the artist, the antiquarian, the historian, geologist, and botanist, or even the mere lounger. Writers of eminence have vied with each other in extolling the beauties of the place.

Buxton owes its reputation and popularity, not entirely to its health-restoring baths and water (*q.v.*), but to its being the centre of a most interesting country, surrounded by picturesque scenery, and within easy reach of many charming places. Buxton is 1,000 feet above sea-level, surrounded by hills 500 to 1,000 feet

high, which protect it from strong winds and the violence of rough weather. The dry and porous nature of the ground and the breezy surroundings insure a bracing climate of absolute purity, highly favourable to the promotion of good health. In this hilly district patients can breathe more freely, and they feel less fatigue after exertion than at many seaside resorts, because the atmospheric pressure on the body is less, and as the air is lighter, exercise can be taken with less fatigue. The baths are supplied with the natural mineral water containing salts of lime, far-famed for the cure of gout, rheumatism, sciatica, lumbago, diseases of the uric acid diathesis and of the nervous system.

Harrogate has an established reputation as a health resort, apart from drinking the water (*q.v.*) of its celebrated springs. Harrogate is midway between the east and west coasts of England, has an altitude of about 400 feet above the sea-level, and is sheltered from winds. The subsoil is sand or sandstone, clay and carboniferous limestone. The atmosphere is pure, dry, and bracing, and possesses the strength-giving properties of moorland or ‘highland’ air. Being dry, it is less chilling than some situations having a higher temperature but moister air. The rainfall is not heavy, and the perfect system of drainage, combined with the nature of the soil, serve to remove it speedily after its fall, and, there being plenty of sunshine, there are few days in the year when the invalid cannot walk out, even in winter-time. The mineral waters of Harrogate are for composition and diversity unrivalled, and the best evidence of their curative power for a variety of ailments is to be found in the many thousands of visitors who flock there.

The English lakes and moors are unrivalled for change of air. The rambles about the Yorkshire moors, as around Harrogate, Ilkley or Aygsforth, are numerous; and the dales, especially Wensleysdale, Ryedale, Teesdale, Swalesdale, are lovely. Grange-over-Sands is bracing, and stiff climbs on the Westmorland and Yorkshire hills can be had from there. Morecambe Bay is free from snow and fog, and has many interesting places within reach, and, like Southport, is suitable for a winter resort. Ambleside, Keswick, Windermere, Coniston, and Ulleswater, are unrivalled; the fine air and lovely scenery of the

Derwentwater, the romantic islands and majestic mountains, afford ample scope for all who desire to combine purity and freshness of air with boating, walking, mountaineering, or sport with rod and gun.

Scotland.—Oban and the Western Highlands and Islands.

Oban has been called the Charing Cross of the Highlands; but, although it is a centre from which the health-seeker may make tours and excursions, it has *per se* a strong claim to be considered as a health resort. Situated on the west coast of Scotland, on the shore of a small bay, which, like many others, has been compared to the Bay of Naples, it has a climate which is mild, equable, and healthy. There is but a slight difference between the mean temperature of Oban and Bournemouth. At Oban it is 48·2°, and at Bournemouth it is 49·4°. The daily range of temperature also compares favourably with that of other well-known resorts; thus the range at Oban is 10·3°, Colwyn Bay 12·6°, Bournemouth 12·2°, Torquay 12·1°. This remarkable equability of temperature is mainly due to the proximity of the town to the warm ocean currents which wash the west coast of Scotland, to the prevalence of southerly and westerly winds, and to its protection from northerly and easterly winds by the surrounding hills, while the islands of Mull and Kerara screen it from the storms of the Atlantic ocean. The first half of the year is the driest. The last three months are the wettest, but they have a temperature as high and equable as that of the South of England. It is a grand place of resort for those seeking rest or change of air and recreation. The season is at its height in August, but those who can choose their time are recommended to go earlier. In June and July the glens have a freshness which they lack in later months, and, while the coaches and steamers are running, every accommodation can be had for rest and enjoyment, and the hotels are not overcrowded. June is perhaps the best month, though it is not hot, for the daylight is the longest, and it enables people to be out of doors from early morning till late at night. From Oban as a centre many places of beauty and romance can be visited by boat or coach; sport can be had by rod or gun; golf and cycling may be enjoyed, and there is mountaineering in plenty. There are scores of lovely spots along the coast and by the lochs where similar advantages may be

obtained, but with greater quietude and less disturbance from the outside world. It would outrun my space to give any account of them. Rothesay, Strathpeffer and Pilkeathley are also well-known health resorts.

Ireland possesses many places which are valuable as health resorts, and there is unrivalled scenery by river, lake, valley, and mountain. The highlands of Donegal have a bracing and invigorating air; Dunraven is called the Brighton of Ireland; and Rostrevor (co. Down), mild but not relaxing, is called the Mentone of Ireland; they are on the Great Northern of Ireland railway. The south-west coast possesses the same climate in a more marked degree as that of Cornwall and Devon. Glengariff (Cork) is said to have a more equable climate than any in the British Isles. Newcastle (Wicklow) and Kilkee (Clare) have an excellent climate, fine air, mild, yet bracing. County Kerry affords not only magnificent and romantic scenery, but Parknasilla, in the neighbourhood of Killarney, claims a climate and sheltered position making it a veritable Irish Riviera.

FOREIGN CLIMATES AND HEALTH RESORTS.

The South-West coast of France, from Bordeaux to Toulouse. The transition of climate from the South-West of England to the South-West of France is easy and natural, for the mean temperature is only about 4° higher; both climates are soft and humid, and agree and disagree with the same class of diseases.

Pau is the only place which needs mention; it is pleasantly situated at the base of the Pyrennees; it has a mild winter and spring, is free from sharp, cold winds and fogs, and possesses a dry soil. It is 6° colder than Rome in winter, and only 2½° colder in spring. Its mean temperature is—in November 47°, December 42°, January 41°, February 43·6°, March 48·8°, April, 51·8°, and its daily range is 10·6°. Its chief fault is said to be an unsteadiness of the temperature. Nevertheless, it is a most favourable place for invalids; and its vicinity to the watering-places of the higher Pyrennees is an advantage which offers to the invalid who has wintered at Pau a healthy summer climate without the inconvenience of a long journey.

The South-East coast of France, from Montpellier to the Var.

This climate is warmer and drier than that of the south-western coast; but it is subject to sudden changes of temperature and harsh, cold winds. The *mistral*, a cold, piercing wind, which sweeps from the bleak central plateau or from the icy region of the Alps, often continues to blow for many days together, and renders it an improper residence for people subject to pulmonary diseases. Many patients were formerly sent to *Montpellier*, but it has fallen from its former high position as a health resort; indeed, its high, exposed situation renders it liable to all the evils of this climate in a marked degree. Marseilles has a sharp, dry air, and forms a good winter residence similar to Brighton, and suitable for the same class of cases. Hyères possesses the mildest climate of this district, which advantage is mainly due to its being situated at the base of a range of hills which protect it from northerly winds; the extensive groves of orange-trees are proofs of the mildness of its climate, which experience has shown to be one of the most favourable in this part of France.

The Riviera is that narrow strip of country from Hyères to Genoa consisting of the coast of the Gulf of Genoa; it lies between the ridge of Maritime Alps and the Mediterranean, where date-palms flourish and orange and lemon groves sweeten the air with the fragrance of their flowers. It is a delightful winter climate, resorted to by hosts of invalids and pleasure-seekers, attracted by its beauty as much as by its health-giving air. Nice, Mentone, Cannes, San Remo, and Bordighera, are amongst the best-known places.

Cannes is one of the most charmingly situated places on the Riviera, and has a mild and uniform climate. Nice is the largest and most frequented town in the Riviera, where the invalid and robust find the best provision for their comfort and amusement. The meteorological reports of both places are similar. At Nice the mean temperature in November is 52°, December, 46·9°, January 45·4°, February 46·5°, March 50·9°, April 57·1, with a daily range at Nice of 11·7°, at Cannes of 9·2°. Nice is protected by a steep and lofty range of hills from the northerly winds, especially the mistral, which is so injurious to invalids in Provence; it has in consequence a milder climate and a comparative degree of softness. It is not, however, exempt from cold winds in the spring; indeed, the prevalence of these constitutes

some objection to the place for persons with pulmonary diseases. A gentleman writing from the Riviera recently said: 'At Nice one is sure to meet with beautifully fine weather, almost constant sunshine; at the same time the air is dry and bracing, sharp and exciting. It is like breathing the air of a lofty mountain charged with an extra dose of oxygen . . . which enlivens and invigorates persons whose system is relaxed and debilitated.' Invalids may remain here until April or May; indeed, they often leave Nice a few weeks too soon, and go to the Italian lakes as much too early. The summer in Nice is too hot for invalids of any class. The climate is suitable for people of languid or torpid constitution, young persons of scrofulous habit, or with chronic bronchitis and profuse expectoration, early cases of phthisis, and chronic rheumatism; and in derangement of health from any cause in which a dry, warm, rather exciting climate is indicated, a winter at Nice will be spent with advantage. The climate is rather apt to upset the digestive organs in persons liable to indigestion or gastric catarrh, and a more abstemious diet is necessary for such persons than in England. The readiness of the air to irritate mucous membranes renders the climate unsuitable for certain cases, such as people who are very liable to catarrh of the alimentary canal, irritable dyspepsia, and other chronic diseases of the stomach, for bronchial disease of a dry and irritable character, or with scanty expectoration, and for persons of a nervous and irritable disposition; nor is it suitable for early phthisis if it is found to derange the appetite and digestive organs.

Mentone is, however, suitable for the class of persons for which Nice is unsuitable, and people go there again and again with advantage to their health. The mean temperature in November is 54°, December 49·1°, January 48·7°, February 49·1°, March 52·8°, April 58°, and the daily range is only about 9·8° F. No watering place upon the Riviera is more picturesquely situated than Monte Carlo; its splendid climate, continuous sunshine, its conjunction of Alpine landscape and luxuriant vegetation, extort the admiration of every visitor.

The Riviera has also many good places, but of cheaper character, for a winter resort: places of quiet calm and beautiful scenery, especially Portofino, Levanto, Sestre-Levanto, Shegic, Nerir,

Spezzia, Viareggio, St. Margherita, Oneglia, Bordighera. Oneglia, between San Remo and Alassio, is a quiet place with a mild, dry climate, and free from the mistral. Bordighera, between Mentone and San Remo, is more sociable, faces south-west, and is protected from the north-east by the hills. A suitable inland resort is Ormea, 3,000 feet high, and about thirty miles from Oneglia. Meran also is sheltered from the winds, has a cold, dry, bracing air, which is tonic and suitable for similar cases as at Nice. Vevey, on the Switzerland side, is a sunny place, not so mild as the Riviera; Montreux, four miles away, is larger than Vevey, rarely has frost or snow, never fog, but plenty of sunshine, and is sheltered from the winds.

Italy is bounded on the north by the famous Alpine range, in the transverse valleys of which are the Alpine lakes, the chief of which on the Italian side are the Maggiore, Como, Iseo, and Garda. Running southwards through the peninsula is the Apennine range, continuous with the Alps, and having the Apennine lakes adjacent—Trasimene, Bolsena, and Bracciano. The coast of the Gulf of Genoa has already been referred to as the Riviera. The lake region is sheltered by the Rhœtian and Lepontine Alps, and thereby enjoys a milder climate than that of the plains further south and at a lower level. The Italian lakes present abodes of interest. Maggiore has celebrated baths; Como, considered the most beautiful, has on its banks picturesque valleys and gay villas surrounded by luxuriant gardens and vineyards; the azure sky, the beautiful blue water, and the towering snowcapped mountains, make up a picture of indescribable beauty.

The climate of Northern Italy has hot summers and rather cold winters, from the nearness of the Alps; the mountain barriers protect the places lying immediately at the foot, but the plains of Lombardy are rendered colder by the northern winds from over the Alps than the centre and south of Italy. The middle section has a pleasant climate, which on the whole is more humid and less exciting than that of the Riviera and Provence. The south is very hot and dry, and suffers from a hot wind from Africa, the *sirocco*, which forms an objection to the Italian climate, but of little weight during the winter months. Genoa has less sunshine, and the air is moister, and therefore

colder, than the Riviera. Florence has a delightful climate, but can be cold from December to February; the spring and autumn are the best times for invalids. Situated in the Val d'Arno, surrounded by the beauties of Nature and Art, it has been called 'the fairest city on earth.' Milan is cold, but not so cold as Florence. Pisa and Rome have a similar climate, but Rome is somewhat drier than Pisa, though both are more humid than the Riviera and Provence; frost is rare, but it may be bitterly cold in the morning. When all the qualities of Rome are taken into account, it is considered one of the best climates for an invalid who can take plenty of out-of-door exercise; but the Lung d'Arno in Pisa provides a more sheltered residence, and is better suited for those who can take little active exercise. Pisa has a very fine climate, glorious sunny days and brilliant nights, but there is a sharpness in the air in winter which makes it necessary to wear more clothing there in the winter months than in Rome; indeed, there is a very marked difference between the temperature in the sunshine and in the shade, and on a cloudy day the wind may be very cold. Both are suitable for nervous, excitable patients, and for consumptives, especially early cases. At Naples the climate is milder than that of Rome, and the temperature is more even throughout the year; it is, however, exposed to the *tramontane*, a very cold, dry wind, which renders it less suitable for invalids, especially those with pulmonary or rheumatic complaints, but it is bracing and invigorating, not really unpleasant. The beauty of the scenery, the yachting, the general gaiety and excitement, render it an agreeable winter resort for those who visit Italy for change of air and scenery, for pleasure and recreation, rather than as a health resort. The diseases most benefited by the Italian climate are chronic bronchitis and rheumatism, but especially cases of indefinite ill-health and early phthisis, where change of air and scenery are required, the season most proper being from October to May or June. The climate of Ajaccio in Corsica, which is the only place on the island suitable for invalids, is between that of the French Riviera and Algiers.

The Alps, properly so-called, is the elevation above 6,000 feet to the permanent snow-line (8,000 to 9,000 feet). It is the system of mountains forming the boundary-line between France, Italy, and Switzerland, occupying a large part of the latter. The

Rhœtian Alps pass into the Austrian Tyrol, and the Dolomites form the boundary between Austria and Italy. The valley of the Inn, called the Engadine, is a famous winter health resort, Davos, St. Moritz, Maloja, and Innsbruck being among the principal towns visited by invalids. Numerous lakes lie in the outer valleys—as Zurich, Zug, Lucerne, Constance, Brienz, Geneva; and on the Italian side the lakes mentioned above. The summer in this mountainous region is very short, and the air is very hot and close in the lower valleys, but clear and invigorating in the higher regions. The winter, owing to the general altitude of the country, is very severe; but the climate is very suitable for certain cases of consumption and other diseases. Patients may reside for months together at Grindelwald, which is 3,400 feet; at Davos, 5,352 feet; or at St. Moritz, 6,000 feet above the sea. Davos may be taken as the chief example; it lies in a valley in the very centre of the Alps, surrounded by mountains whose sides are covered with pine forests, and possessing a geological formation that insures immunity from damp, at the same time enjoying a favourable exposure to the full rays of the sun, even on a winter's day. The air is much rarer than at sea-level, the atmospheric pressure being one-fifth less, and it is extremely pure and dry; there is a marked absence of clouds, but there are long periods of sunny days, which enable the invalid to sit in the open air for many hours daily. It is a bracing, tranquil atmosphere, undisturbed by the 'mistral' and other cold winds, free from dust, fog, and damp, and forms a climate admirably suited to the particular class of patients sent there. There is no particular season, as patients reside there the whole year round, but those patients sent in June, July, or August get acclimatized to the atmospheric influences before they are called upon to bear low temperatures to which they have never been accustomed. Invalids are sometimes startled when they are told that they are to look for a cure in the cold, bracing climate of a high-lying Alpine valley, instead of turning their steps to the warm and seductive South; but the proof of its curative effect is found in the increasing numbers which are benefited by it year by year; theoretically, its influence is not well understood, but practically it is very successful.

Sir Herman Weber said the main features of a mountain air

should be: purity, comparative absence of floating matter, dryness of the air and soil, coldness or coolness of the air, but great warmth of sun temperature; intensity of sunlight; rarefaction and stillness of the air, a large amount of ozone—all of which are claimed for Davos. The same authority classifies the cases of consumption which are suitable for treatment by a climate of great altitude thus: Hereditary and acquired tendency to phthisis; the so-called phthisical habit; all other conditions comprised by the term phthisis, excepting the following *unsuitable cases:* persons who cannot eat or sleep, or feel the cold too severely at high altitudes; cases of advanced phthisis; persons of irritable constitution; cases of continued fever, rapid progress of the disease or loss of weight, or complicated by emphysema, empyema, albuminuria, ulceration of the larynx, or disease of the heart. Cases with a tendency to hæmoptysis show most satisfactory results, but they should make the journey up by easy stages (see also the chapter on 'Consumption'). The mountain climate is also to be recommended for all invalids of a relaxed and debilitated constitution, for many cases of debility, anæmia, scrofula, and convalescence from long illness; for delicate individuals of both sexes; and for persons who are suffering from overwork, too great a tension of brain or body, insomnia, and various neuralgias and other nervous affections, and all who are anxious to spend their holiday both pleasantly and profitably while regaining physical or mental vigour.

Leysin is a climatic station in the Vaudois Alps, 4,785 feet high, surrounded by pine forests, possessing the qualities essential for tubercular patients: purity of air, freedom from dust and organic matter, dryness, low temperature, brilliant sunshine, and claims all the advantages previously spoken of.

Austria.—The Austrian Alpine district includes the Dolomites, the Stelvio, Salz-Kammergut, Puster, and Ampezzo valleys; the lake of Garda, and the beautiful Inn Valley (Innsbruck); also Lake Constance, Baths of Bormio, Bad Gastein, Gries, Meran, Levico, and Carlsbad (Bohemia). The Kitzbuchel, in the Northern Tyrolese Alps, 2,526 feet above the sea, backed by the Dolomite peaks, has great climatic and picturesque advantages; it is mild, equable, and almost windless, and is favourable as a resort in the winter months for early phthisis and all kinds of patients

requiring a cool dry air; there is ski-ing, skating, and other amusements as at Davos and St. Moritz. Innsbruck, the fashionable capital of the Tyrol, has an autumn and winter climate suitable for persons who need their constitution to be built up as a preventive measure, and for the same class of patients as at Davos. It is surrounded on all sides by high mountains, fully protected from north winds; when cold, it is a dry cold; when there is a wind, it is usually warm. In Austria *the Grape-cure* is taken at many places in the autumn, as in the Tyrol, Meran, Botzen, and Gries, which towns are in the midst of great beauty, sheltered from the north, open to the sunny south. Grapes also form part of the 'cure' at Wiesbaden and other places. The cure, which occupies six or seven weeks, consists of the consumption of from 3 to 12 or more pounds of grapes per day, the quantity being gradually increased. Naturally, the diet which accompanies them must be simple, and should be taken in accordance with medical instruction; and the grapes are best swallowed after just cracking them with the tongue, as chewing so many would injure the enamel of the teeth. The grape-cure is very suitable for some forms of dyspepsia and other affections of the stomach and bowels, for consumption, anæmia, chlorosis, some diseases of the kidneys, and alcoholism; it is *contraindicated* in cancer of the stomach and other organs.

Germany has many watering-places of note, as at Baden-Baden, Wildungen, Homburg, Bellthal, Driburg, Selters and Salzschlirf (Bonifacius), in Hesse Nassau; all along the Rhine Valley and in Rhenish Prussia are many places of beauty and charm, where persons may recuperate: at Gerolstein in the Eifel Mountains, at Aix-la-Chapelle, at Roisdorf near Bonn, at Kreuznach, in the Taunus, and the Neuenahr, especially at Nauheim, which places are referred to in various sections herein. The Black Forest can be recommended for many people. Freiburg is a charming town with a bracing climate and balsamic air from the pine-woods, very suitable as a general resort for persons of ill-health, and is a centre from which excursions into the forest can readily be made.

Belgium has resorts which can be recommended both for their salubrity and economy. Ostend, Adinkerke La Panne, Blankenberghe, Coq-sur-Mer, Duinbergen, Nieuport-Bains, and Wenduyne,

have an invigorating air and a combination of sea and rural charm. Spa is a celebrated watering place.

Spain and Portugal.—The Pyrenees in the north form a magnificent range of mountains little inferior to the Alps, where health-giving breezes and a pleasant climate render the district of value to many people. There are numerous places, like Barèges, Amelie, Boulou, Vernet les Bains, Carnigou, and Rubinat, with their waters, where health may be sought by change of climate, scenery, and the adjuncts of medicated baths and waters. The great elevation of most of the *central* districts of these countries causes the winter temperature to be low, while great heat prevails in the summer. In the south and east the climate is hot, and tropical plants grow freely. On the Portuguese side of the coast, Lisbon, on the Tagus, and Cintra, a few miles from it, are beautifully situated, the latter place being much resorted to by the wealthy natives. Mont'-Estoril is called the Riviera of Portugal. Oporto has a charm partly natural and partly artificial; the Douro flows between banks of the richest foliage; Bussaco, 2,000 feet above the sea, is simply superb with its olives, oranges, pomegranates, and eucalyptus. Yachting off Portugal in a warm sea provides the means of being out of doors day and night, and is very suitable for many people. The Spanish coast may also be a similar means of providing yachting expeditions into the Mediterranean. Huelva, in Andalusia, is suitable as a health resort: average temperature, December 59°, January 56°, February 63°, the night temperature being 4° to 8° less.

The Islands of the North Atlantic Ocean in temperate latitudes have a climate which is more steady than that of the Mediterranean health resorts; and various groups of islands between the 28th and 38th degree of latitude are frequented by invalids who require a mild and equable climate. Bright's disease, chronic rheumatism and gout, consumption and other diseases of the respiratory organs, and some nervous diseases, are indications for which these places are best suited.

Madeira is one of these, and stands in great repute. Being in latitude 32° 40′, its mean temperature is in November 65·8°, December 63·2°, January 60·4°, February 61·2°, March 61·2°, April 64·0°, and its daily range only 5·4°. A comparison shows the mean annual temperature to be about 6° higher than that of

Nice and Rome; the winter is 12° warmer than that of Italy and South France, and the summer is 6° cooler. A central ridge of mountains tempers the heat in summer, and gives Madeira the advantage of a cool land breeze during the night, which, by alternating with a sea breeze in the day, moderates the summer heat in a remarkable degree. Invalids may choose an inland situation as being cooler in the summer, while Funchal, the chief town on the coast, affords the best winter residence.

The Canary Islands have nearly as great repute as Madeira. This group of islands are also in the Atlantic, not far from the west coast of Africa. The chief towns are Teneriffe and Grand Canary, between 27° and 30° north latitude. Being further south, the mean annual temperature is somewhat higher than that of Madeira, and the climate is not so equable. These islands are, however, very suitable for invalids. Santa Cruz is 200 to 300 feet above the sea. In winter and spring the average mean temperature is 65° F.; the average humidity is 65°; average yearly rainfall 11·5 inches. There is an abundance of sunshine, and no sudden changes of weather. The nights are warm and a little dew falls, and there is always a pleasant breeze from the sea. Chest cases, Bright's disease, gout and rheumatism, are especially benefited by the climate.

The Azores lie far out in the Atlantic, in about the same latitude as Lisbon, a few degrees further north than Madeira. The chief town is St. Michael. These islands have a fine climate, mild and humid, less warm than Madeira in winter, but more oppressive in the summer. They possess no advantages over the latter.

The Bermudas are a cluster of islands in the same latitude as Madeira, and have a similar climate—mild in winter, but extremely hot in the summer, and exposed to the high winds of the western Atlantic.

North Africa has a climate which is well suited to invalids—those who must rest as well as those who are able to travel and obtain change of scenery and occupation.

Algeria is a land of sunshine, with a climate which competent authorities have pronounced to be one of the finest in the world. Most of Algeria is a high land, and well sheltered; the neighbourhood of the sea exercises a softening influence on the

atmosphere, so that, without being too dry, dryness predominates everywhere. It is a region of charm and novelty, of camels and Arabs, of palms and other tropical plants, of mirages and glorious sunsets. The mountain scenery is claimed to equal in sublimity that of Switzerland. A combination of European and Mahommedan interests opens up to us a thousand historical memories and customs, but, nevertheless, presents all the conveniences of civilization. Winter is the best time for travelling through Northern Africa, which is in the same latitude as Syria, Japan, and California. For the invalid, however, the best season is from December to March. The land is filled with glorious sunshine, and the air is usually warm ; nevertheless, warm clothing should be provided, for some of the mountains are covered with snow for six months in the year, and cold winds occasionally blow from them. It is advisable, therefore, to wear the same clothing as in England at the same season. A few hygienic measures are recommended until one is acclimatized, such as avoiding the mid-day heat and the night fogs. Perhaps also it is better to take a tonic on arriving and to dilute the wine with mineral water, or only to drink weak tea or coffee. Algeria is a vast sanatorium, and many of its towns and villages are in suitable spots for invalids; indeed, two special places — Algiers and Biskra—have a preference which is supported by meteorological observations. The rainfall is small at both : Algiers = 740 millimetres (29·3 inches) and Biskra = 200 millimetres (7·8 inches). The rain is small and falls irregularly—just enough to wash the sky and soak the ground. The temperature is as follows :

	Mean of Year.	July.	January
Algiers	65° F.	75·6° F.	53·8° F.
Tlemcen	61° F.	77·1° F.	30·8° F.
Biskra	70° F.	79·9° F.	54·1° F.

November temperature { Algiers, maximum, 69° F. ; minimum, 55° F.
{ Biskra, ,, 75° F. ; ,, 50° F.

Either place is suitable for the invalid, according to personal feeling and convenience.

Algiers claims to have a climate which is warmer and more equable than that of the Riviera or Pau, but it is less stimulating than Nice or Cannes. It is neither too hot nor dry, but is intermediate between a dry, stimulating climate and a warm, moist one. The total rainfall exceeds that of Paris ; but there

are few rainy days, and it falls mostly at night. It is favourable to persons suffering from early phthisis, cardiac disease, asthma, bronchial complaints, and other diseases of the mucous membranes. *Mustapha* is a beautiful suburb of Algiers, about three miles above it, equally suited to the same cases. Below it is the blue Mediterranean ; above it the land rises to a height of 3,000 feet ; the temperature rarely drops below 45° or 50° F., and is usually between 55° and 60°. Snow is unknown. Thence, many journeys may be made of interest to the historian and antiquarian, while the botanist, geologist, and ornithologist will find abundance to interest him.

Biskra, an oasis on the edge of the Sahara Desert, with its palm groves, has a delightful climate, and in winter many people flock there. The sirocco and simoom may come and bring with them an impalpable dust ; but these are dry, hot winds, and not so injurious as a hot, moist wind, and they rarely come in the winter months. The rainfall, as observed, is very low. It is very suitable for most cases of consumption, and a large number of invalids go there, also for chronic bronchitis with profuse expectoration. It is also recommended for cases of nervous depression, moroseness, ennui, and many nervous complaints. A short distance off are the sulphurous thermal springs and city of Sidi-Okba, where the waters may be taken for the same complaints as those from other sources. It is a fashionable resort.

Other places will also claim the attention of the invalid who is able to travel, as *Tunis*, with the ruins of ancient Carthage.

Oran, at the foot of the Djebel, has beautiful surroundings, and is a centre from which Tlemcen, the Holy City, and Hammam-Meskoutine can be visited. At the latter place is the group of hot springs with medicinal waters. Baths are open in the season, and render useful service by contributing to the establishment of health in cases of Bright's disease, diseases of the pelvic organs, chronic rheumatism and gout, and all kinds of chronic inflammation. This place is in the midst of lovely surroundings—mountains, with pine-woods one over another being behind it, and the Mediterranean in front.

Egypt is a grand winter resort, especially Cairo and Luxor. Light dresses, as for July in England, are usually worn, but the cold is sometimes severe, and warm underclothing and wraps

should be provided. The hotels and pensions at Cairo and Luxor are replete with modern conveniences, but they open on the dusty street, and therefore are not all that should be desired for consumptives. But special accommodation is provided for the sick at *Helouan*, about fifteen miles from Cairo, just within the area of the Libyan Desert. Here the air is dry and free from organic taint, and dust is not breathed, as it never rises to the level of the mouth except in a storm. The Egyptian climate is very suitable for early phthisis, and even in advanced non-feverish ones the disease is arrested. It is also indicated in Bright's disease, chronic rheumatism, anæmia, syphilis, and laryngeal affections. The cold season is short, but is capable of doing harm to invalids who live in hotels or houses where no adequate means of heating them is provided. The bright sunshine is a factor in curing patients, by increasing the activity of the skin and general metabolism. Nervous patients do not bear it very well at first, but they soon become accustomed to it if they keep in the shade during mid-day. The time of departure from Egypt depends upon the patient. Those with heart disease should leave at the end of March, before the heat becomes too great for them; but the usual time of leaving this country for all other cases is the beginning of May.

Morocco is a good place for those who are run down, but not really ill, especially for good sportsmen. The life is mostly in the open air, travelling by horses or mules, and sleeping in tents. The principal shooting-grounds are near Larache, Alcazar, and Wazzan; but Tangiers, Tetuan, and Ceuta have a good climate. The best time is in October and November or February and April. The chief feature against it is the unsettled state of the country at the present time.

South Africa is a health resort. Cape Colony has long enjoyed a reputation for the salubrity of its climate, and reports of a uniformly favourable character have been made by medical men all over the Colony, which establish incontestably the beneficial effect of the climate upon all suffering from chest diseases.

Cape Colony has an extended area, and presents varied physical features—high mountains, low valleys, elevated table-lands, and a variation of climate in accordance with them. The seasons are not so well marked as in Europe. Spring merges

into summer, and there is little change between autumn and winter. At Christmas it is nearly midsummer. The spring (October to December) is the most delightful season. The heat is nowhere excessive, but in the valleys it becomes very oppressive. There is a maximum of sunshine, buoyant atmosphere, clear and cloudless blue sky, and a cool night succeeds a warm day. The mean annual temperature is 61° F. in the shade. The excessive dryness, clearness, and rarefaction of the atmosphere, added to other characteristics, are a series of conditions typically suitable for the treatment of pulmonary diseases. The rainy season varies in different parts, being in the winter on the south and south-west coast and in the summer on the eastern coast, so that the invalid need have no difficulty in getting from place to place to avoid the wet. It is recommended that the most advanced cases of chest diseases should winter on the plains and pass the summer on the elevated mountain lands of the interior. Sufferers from bronchial, asthmatic, and all pulmonary diseases, especially those with inherited tendency to phthisis, are benefited by the climate; but the patients should be selected as for other places, and they are advised not to tarry too long in Cape Town, but to go to a locality up the country, as Ceres, etc.

The eastern district, where Grahamstown is situated, is divided into three divisions: *The coast plateau*, with East London, Port Elizabeth, Bathurst, etc., up to the first mountain range, about 1,000 feet high; *the midland plateau* or terrace, including Grahamstown and King William's Town, between 1,000 and 2,500 feet above the sea; and an *upper plateau*, with an altitude of 2,500 to 5,000 feet above sea-level, including Aliwal North, etc. The coast climate is warm, moist, and equable; its winter cold is moderated by the sea. The climate of the midland terrace is cooler, drier, and more genial, but with greater range of temperature. The upper plateau or mountain climate is drier still, more bracing, but has hot days and cold nights. Grahamstown, in the midland region, has the advantage of an elevated site, fine climate, and pure air. Patients can easily be moved up or down—to the soft warm balmy air, where frosts are unknown, or to a dry mountain air. Comfort and luxury are within reach, and pleasurable occupation

or amusement suitable to every taste. Deep, wooded kloofs afford abundant excitement to the sportsman, shady pools give attraction to the angler, and picturesque scenery affords in all seasons pleasing change and variety. The district of Aliwal North in the upper plateau is recommended as a valuable resort for the treatment of phthisis by the 'altitude' method.

The Karoo District has a climate of extreme dryness, severe and prolonged droughts, hot days and cold nights. The temperature, although great, is better borne than in regions where the atmosphere is moister. Dr. Sanders says: 'The winter is the best for pulmonary invalids; the air is remarkably clear, bright, and bracing, and a fire is generally a luxury rather than a necessity, though the night and early morning is cold, and snow falls on the higher mountains.' The Karoo climate is favourable for an out-of-door life. In the summer the whole day can be passed in a well-shaded veranda or a hammock slung on trees, and in the winter the calm dry air is inviting to exercise. In the summer the evenings can be utilized for exercise if the patient is prudently clothed.

Kimberley is on the high inland plateau, about 4,100 feet above the sea; it has a rainfall of 18 inches; mean humidity, 55 per cent. of saturation; sunshine very great; temperature (mean), October to March 72°, April to September 56°.

Speaking of the class of persons most suitable for climatic treatment in South Africa, Dr. Symes Thompson said: 'It is useless to send to South Africa a man or a woman whose comfort depends on the luxurious surroundings of home life, and who will never cease to grumble when difficulties arise. . . . What is really more important than the nature or the stage of the disease is the character of the patient and his readiness to enter into and enjoy his new life. He should be a man of resource, and able to interest himself in the life of his neighbours.'

The West Indies, which consist of a great chain and many groups of islands, are almost entirely within the tropics. The air is always hot, alternately wet and dry, and hurricanes occur between July and October. Tours in the West Indies should be taken between November and April; the weather is then charming, fresh trade-winds blow during the day and temper the heat, hurricanes are unknown at this time of the year, and, excepting

for the tropical vegetation, the visitor would imagine he was in England in the month of August. The islands have a beauty of their own, not to be found in the tropical continents. The Blue Mountains, rivalling the Alps in height, added to a luxuriance of vegetation and a climate which Froude called 'inimitable,' make a charm beyond compare. The temperature is never below 60° F., but the tropical heat is tempered by the breeze which blows daily from the sea and nightly brings a freshness from the uplands. Europeans find pleasant homes on the higher lands in most of the islands. *Jamaica* is the largest of the British West Indies. It is mountainous, with a belt of lowland near the coast. Situated in the Caribbean Sea, with the Gulf Stream flowing about it and the trade-winds over it, and a lofty range of mountains extending its entire length, it forms a delightful health resort, and is recommended as an ideal land of rest and comfort. The atmosphere, laden with spices and sparkling with mountain ozone, is constantly in motion, and the temperature varies only between 70° and 80° F. all the year round. Mosquitoes, flies, frogs, snakes, and fogs are practically unknown. The delightful scenery, the pure warm air, the balsamic odour of the spices, the ample means of recreation, the good hotels and boarding-houses, and the ample means of visiting other islands or making a tour of them all, combine to make Jamaica a suitable resort for pulmonary, renal, and many other classes of invalids throughout the winter months.

America is so vast as to afford climates of every description.

Canada has a lower temperature than that of Europe in the same latitude ; the cold of winter and the heat of summer are both greater ; the western provinces are warmer than the eastern. The western winds from the Pacific Ocean raise the temperature in the States on the Pacific slope, but at the same time cause a considerable rainfall, and the cold Polar current causes the eastern provinces to have a lower temperature ; but the climate is remarkably uniform over very large areas, and is bracing and invigorating.

The United States also have hotter summers and colder winters than occur in the same latitude in Europe ; the western States and coast are less subject to the rigour of winter and excessive heat of summer, owing to the influence of the warm winds from the Pacific ; the eastern States have a drier climate, but

are more subject to extremes of heat and cold. The whole country is subject to great changes of temperature, known as *hot or cold waves;* very cold winds are called *blizzards*, and very violent ones *tornadoes.* The atmosphere is very fine and clear, owing to the dryness of the winds which sweep over the continent from the west. The absence of a mountain range from east to west causes the cold northern or hot southern winds to be felt for long distances. The influence of the Gulf Stream is felt along the Atlantic coast from Florida to Cape Hatteras, which causes the difference of climate between the winter of that region and New York. From there being such extremes of heat and cold, it may be perceived that every part of the United States is not equally suitable for the person of delicate health. There are, however, very many health resorts at favourite spots along the sea-coast and by the great lakes, at the sources of many of the mineral waters (*q.v.*), in the warm southern States of Arkansas, California, Texas, Carolina, Florida, New Mexico, or in the Adirondack Mountains and the high and dry regions of Arizona. A few particulars only can be given.

Long Island is far out at sea, off the coast of New York. The greater part of its subsoil consists of sand and gravel, and the land steadily rises from south to north. Through the centre is a range of hills covered on the south by pine-trees. The mean annual *temperature* is 51·8° F., mean summer, 70°, mean winter 30°. The mean annual temperature of New York City is 52°, Atlantic City 52·7°, Nantuchet 49·5°. The humidity of Long Island is especially low in the pine region, and is lowest in winter and spring; the reverse occurs on the mainland. This also compares favourably with inland places: *Humidity* of Long Island = 72·7 per cent., New York State 75·5, Block Island 84·5, Atlantic City 80·5, San Diego (California) 69·5. *Sunshine:* The average of all days on which the sun shines sufficiently to take out-of-door exercise is as follows: Long Island 300, Nantuchet 200, Atlantic City 260, Denver (Colorado) 312, and Phœnix, in Arizona, 330.

The prevailing wind of Long Island is in summer south and south-west, cooled by the Atlantic Ocean; in winter north-west, with long periods, when it is south-west. The pine forest is six or eight miles wide, and extends for sixty miles through Suffolk

County, between the central range of hills and the south shore. It is claimed that Long Island has a mild and equable climate, with abundance of sunshine, absence of moisture, air free from organic and inorganic impurities, but containing balsamic exhalations from the pine-trees and iodine and bromine from the sea, which make it eminently suitable for 'increasing the functional activity of the circulatory organs, for convalescents from acute diseases, to accelerate tissue changes in surgical diseases; for invalids who cannot bear changes of temperature; for tuberculosis, neurasthenia, nervous exhaustion, and insomnia (Ross).

Colorado.—Colorado Springs has a fine climate with plenty of sunshine and almost cloudless skies; the summer is not too hot, the nights are cool, the days seldom, if ever, uncomfortably warm; never muggy, but always balmy zephyrs; a warm winter resort for early cases of phthisis. *Denver* is well elevated; has 42 per cent. of clear days, which compares well with the 27 per cent. of New York; it has a dry, bracing atmosphere, free from dust. Early phthisis, neurasthenia, and many cases of ill-defined ill-health are benefited by this climate.

Arkansas, in the neighbourhood of Hot Springs, has a mild climate lacking the extreme heat of summer and cold of winter; in summer-time the air is tempered with breezes from the mountains, and in winter the average temperature is only slightly below that of New Orleans and other Southern cities, but there are occasional sharp frosts. The hot springs are in a valley at an elevation of 1,000 feet above the sea, and about 600 feet above the surrounding country. The waters are drunk for gout, rheumatism, and other diseases treated by the alkaline and saline waters (see 'Waters').

California has hot and cold mineral springs of medicinal value in nearly every county of the State. At many of the sources of these waters Nature has been bountiful in the bestowal of a delightful scenery and climate, so that they are much resorted to by persons in search of health (see 'Waters'). There is every diversity of climate in this State, ranging from the dry air of the deserts to the warm, moist air of the sea-shore, or the invigorating air of pine forests and mountains. The mean annual temperature is 50° F., neither hot nor cold. Snow falls once in many years, roses bloom throughout the winter. The trade-winds from

the Pacific make San Francisco a valuable health resort, as well as Los Angeles, about 300 miles below it. Other seaside resorts are Santa Barbara, Santa Monica, Long Beach, and Newport. The climate is delightful; infrequent are the days when invalids may not be out of doors breathing a fresh and healing air, thereby regaining strength. The Palm Valley and Springs, guarded by the San Jacinto mountains, and on the desert's edge, have a purity of air and dryness (*humidity* averages 15 per cent., and may be as low as 9) which render them valuable resorts for consumptives and others. Santa Ysabel, near Paso Robles, has no peer in California as a health resort; it has warm and sulphurous springs, and is in the midst of beauty. The mountains of Santa Jacinto, Gorgona, and Bernardino provide a mountain climate with a warm dry air. Temperature: San Francisco, maximum 80° to 95°, minimum 30° to 40°, mean 54° to 58°; Los Angeles, maximum 92° to 108°, minimum 28° to 36°, mean about 61°; Sacramento, maximum 100° to 108°, minimum 19° to 34°, mean 59 to 60°.

New Mexico.—The Las Vegas hot springs are at an altitude of 6,767 feet, surrounded by an equable and invigorating mountain climate, tempered by altitude in summer and latitude in winter, and in almost constant sunshine. Similar remarks apply to the mountainous region of *Arizona*, where the high, dry atmosphere, the warmth and sunshine, make a climate admirably suited for incipient phthisis, Bright's disease, rheumatism, nervous diseases, and general debility.

Florida occupies the whole of the peninsula which bounds the Gulf of Mexico on the east, and it is therefore surrounded on three sides by the sea, and is especially influenced by the warmth of the Gulf Stream. The climate is very mild and equable, and the district is a grand winter resort for persons who suffer from tubercular and pulmonary diseases generally, chronic gout and rheumatism, for delicate children, aged persons, and all who need a warm and moist climate.

Australia has a climate which is generally healthy for Europeans, but the temperature varies from tropical in the north to warm temperate in the south. The atmosphere is remarkably dry over almost the whole continent. Most winds are from the south-east, and hence the eastern coast regions have a good rain-

fall throughout the year, but over the great plains of the interior rain is scanty, and the air becomes hot and rarefied during the hot season. The elevation of Queensland causes the temperature there to be less than it otherwise would be, and the cool winds from the southern ocean modify to some extent the heat of summer by counteracting the heat from the interior. In Victoria the highest known temperature is 111° F. in the shade and the lowest 27°; generally it goes over 100° about three times in a year, and freezes about as often. The average rainfall is 25·5 inches per annum. In New South Wales the temperature is never very low, and the snow-line on the mountains is high; the climate is very dry as a whole, but the rainfall varies from 51 inches per annum near Sydney to 11 inches in some other parts which are subject to great droughts. Almost all parts of the colony are very healthy.

New Zealand has a warm temperate climate; there are no extremes of temperature in the lowlands, but the winter is very severe in the mountainous regions. Generally speaking, the western coast has a more equable temperature than the eastern. The prevailing winds are from the north-west, and bring rain with them. The rainfall at Hokitika, on the west of South Island, is 112 inches, but at Christchurch is only 28 inches; in the North Island the rainfall is 58 inches per annum at Mount Egmont and 37 inches at Napier. While the great elevation of much of the land lowers the temperature, the vast body of ocean on all sides moderates the heat of summer. The coast towns and residences are much sought after during the hot season and as health resorts.

The voyage to Australia or New Zealand from April to September is often prescribed for consumptives, but it cannot always be beneficial to them, as they must pass through a variety of climate. It is injurious to be exposed to cold, windy, and wet weather or insufferably hot weather; in one part of the voyage the temperature may be excessively hot, in another bitterly cold, with tempest and rain. It is recommended that the patient should not go by the Suez Canal route, as he will be in contact with the land every few days, and each fresh start may cause sea-sickness, and from the Canal to Cape Lewin the atmosphere is steamy, and not beneficial (three weeks). By the Cape route,

however, these dangers are avoided: he will go through the tropics in a direct line, which will give him a maximum of hot weather, all the rest of the voyage being practically cool. The trip occupies about seven weeks, which is a little longer than by the other route, but in favour of the consumptive. It is argued that travelling by steamer brings a too rapid change of climate for the febrile consumptive, whereas a sailing vessel encounters those changes more gradually, but is in danger of being becalmed, and having to wait many days for a favourable wind. The sea voyage provides abundance of sunshine and fresh air uncontaminated by dust or other particles; metabolism is thereby increased, and when 'appetite waits upon good digestion' the patient sometimes puts on a stone or two of weight during the voyage out and home. In favour of sailing vessels, it may be said that there is no throbbing of machinery, no smell, no cramping of space, and the life on board, even if monotonous, is peaceful and undisturbed. In all cases patients are warned against overeating, as there is little exercise to be had on board, and against sleeping at night on the deck, even in the tropics, as the temperature is uncertain. A voyage to South Africa and back in the autumn, or to South America or the West Indies from January to April, is of equal value in proportion to its duration. These voyages may be taken by persons with early phthisis, phthisis, convalescence from pneumonia, pleurisy, and some kinds of chronic bronchitis, and also by people worn down by overwork or worry, insomnia, neurasthenia, and other nervous diseases.

In concluding this chapter on the climatic treatment of disease: consumption is a malady in which a change of climate may be of real benefit, but it should be tried early in its course if it is intended as a curative measure. It is especially in that peculiar state of deranged health which may be called pre-phthisis, and in those with inherited tendency to the disease, before there is any actual manifestation of trouble by deposition of tubercle in the lungs or hæmoptysis, that change of climate is a powerful adjunct to other modes of treatment. Sunshine and pure air are of importance to all people, but their value for early phthisis, phthisis, persons of a delicate constitution, and those broken down by disease, cannot be overestimated. A proof of this may

be seen by contrasting the children of the slums and closely-populated districts of our large towns and cities—pale, stunted, and liable to disease—with the chubby-cheeked, vigorous children seen in our country lanes and villages.

Certain general characteristics will be found in the place which is best suited for the consumptive: it should be near the coast, and sheltered from the cold winds; the soil should be dry; the mean temperature such that he can spend a large part of his time out of doors, and bear to have his windows open night and day; the temperature should be equable, and its range should not be more than 10° or 12° F. It is difficult to fix any degree of humidity, but an excess is injurious, especially if fogs abound or cold winds are prevalent. A warm, moist atmosphere is best for those who have a dry, irritable cough, without or with little expectoration, and a warm, dry atmosphere for those who have more expectoration. A continuous dry, cold atmosphere is very good for some cases, and is a main feature in the altitude treatment (see 'Alps'). One may judge of the beneficial effect of the climate by its influence upon the appetite, and upon the cough and breathing. If the cough becomes less, the breathing free, and expansion greater, the effect is good. The effect of a warm, moist atmosphere on a delicate-chested individual is that he can breathe with greater freedom; the softness of the air exerts a soothing influence on the lungs, and, no longer afraid to take a deep inspiration, air is drawn more freely into the chest, greater expansion takes place, and the general condition is improved. When the temperature of the air is fairly high and equable, the daily range being small, more watery vapour can be held in suspension by the air; but if the temperature of the air is lower or the nights are cold, owing to a greater range of temperature or other frequent variations, then the moisture in the air becomes visible and sensible, and it settles down in the form of fog or mist, and the place, instead of being mild and genial, becomes raw and cold—such is not the place for consumptive or weak-chested persons. Every place suitable for invalids must have enticing surroundings, and beautiful scenery, so that the patient may be encouraged to spend his time out of doors in walking, riding, or other exercise, or basking in the sunshine; and it is better that the house he occupies should be

in a district where the houses are scattered and detached from each other by a good space around them, rather than in one where the houses are clustered together, however small the population may be. The patient who is threatened with phthisis, or is in the early stage, or has well-developed phthisis, may spend the winter with advantage in the South of England or South-West of Ireland. Ventnor or Undercliff and the Scilly Isles are suitable for the whole winter; or the autumn may be passed in one of these places, and from January to April at Bournemouth, Torquay, Falmouth, Penzance, Hastings; the spring at Margate, Tenby, or Southport; and the summer at other seaside places, such as Hunstanton, Cromer, Skegness, Sutton-on-Sea, etc., on the east coast, or at Aberystwyth, Llandudno, Blackpool, Grange-over-Sands, Isle of Man, or in the dry and bracing climate of Clifton, Malvern, Buxton, Matlock, Harrogate; and June or July is the best month to go to Oban and begin a tour in the Scottish highlands or islands, which may last through August and September, to the patient's advantage. In most cases, those who have passed the winter in the milder health resorts of the south ought to pass the summer in a drier and more bracing air, where exercise can be taken. The early months of the year may be passed at Marseilles, Pau, Hyères, the Riviera; from March to May or June in Italy, at Pisa, Rome, the Italian lakes; the summer is best spent at home, or in a voyage to the Cape or to Australia and back, and this also is the best time to begin residence at Davos or other mountainous sanatoria; the autumn may be spent in South Africa, or the whole winter at Madeira, the Canaries, Egypt, Algeria, Jamaica, Florida, New Mexico, or California.

In chronic bronchitis the morbid conditions of the mucous lining of the bronchial tubes, trachea, and larynx are usually greatly improved by a change from a cold, damp air to a mild and dry one. As a general rule, the situations which are suitable for phthisis will also agree with a patient suffering from bronchitis. But the cases may be divided into two classes: those of dry bronchitis, in which there is an irritable state of the mucous membrane without much expectoration; and the second class, in which the mucous membrane is much less sensitive, but there is a copious secretion of phlegm and a relaxed state of the

system generally. For the first class a warm, moist climate, like Torquay, Penzance, Scilly, Hastings, Undercliff, Mentone, San Remo, Florence, Madeira, the Canaries. For the second class of cases a long sea-voyage is sometimes beneficial, and a warm, dry climate, like Bournemouth, Brighton, Tenby, Clifton, the Riviera, Pisa, Rome, Algeria, Egypt, South Africa.

In cases of chronic rheumatism, the climates of Rome and Nice, Algiers and Egypt, are very good; but the health resorts where mineral waters are drunk and baths of the same are used are equally important, as Buxton, Matlock, Woodhall Spa, and Droitwich in England, Contrexèville and Maggiore on the Continent, and Hot Springs, Arkansas, U.S.A.

Good climates for gouty affections are Genoa, West Indies, Egypt; but, as in rheumatism, drinking the waters and using medicated baths at their source is also very good.

There are several groups of diseases which may be mentioned together. The climates of Margate, Skegness, Tenby, Aberystwyth, are recommended for tubercular diseases of glands, bones, and joints, for diseases of the spine, and general debility dependent on a strumous, scrofulous, or cachectic condition; also Woodhall Spa in Lincolnshire, St. Moritz and Kreuznach on the Continent (see 'Waters').

A warm, moist climate, like Falmouth, Penzance, Torquay, the Scilly Isles, Isle of Wight, Mentone, San Remo, is recommended for the debilitated, aged, and those who have a winter cough, laryngeal troubles, asthma, chronic bronchitis of a dry, irritating character, for a large number of phthisical cases.

A warm, dry climate like Brighton, Bournemouth, Margate, Nice, Cannes, Pau, Rome, Pisa, Algeria, Egypt, South Africa, for those with passive congestions, copious secretions from all mucous surfaces, uterine discharges, and a relaxed state of the general system.

A dry, bracing climate like Malvern, Clifton, Buxton, Matlock, Ilkey, Harrogate, Scotland, Switzerland, and other hilly or mountainous resorts, is suitable for all cases of relaxed states of the system, passive congestions, debility, anæmia, neurasthenia, and nervous diseases generally.

The period of returning from the milder and warmer regions where the patient has been sojourning ought to be carefully con-

sidered. The invalid may be so much improved as to consider himself well, and be impatient to return home. Influenced by this and other reasons, he may leave a southern climate too early, and so induce a relapse of the disease which he set out to cure. The patient who has wintered in a warm climate should not return to a more northerly, cold, and windy region until the spring is well advanced, or even until summer-time. If he has spent the winter in Italy at Naples or Rome, it is better for him to remain about the Italian lakes until June ; similarly, if he has wintered in Africa or in the Canaries or Madeira, he should not leave his winter quarters too soon, for he will find a perceptible difference in the temperature, and will probably require additional clothing.

TROPICAL CLIMATES.

Africa.—The greater portion of Africa is in the torrid zone, by reason of which the climate is very hot ; although, when compared with the tropical area of other continents, the temperature has a greater uniformity. Algiers, in the north, has a temperature of 74° in summer and 54° in winter ; Cape Town in the south averages 67° in summer and 54° in winter ; Sierra Leone, which is nearer the equator, has a temperature of 82° in summer and 77° in winter, with an annual range of only 5° ; the mean temperature of the continent is, however, about 80° F. The seasons are governed by the rainfall, and dry and wet seasons follow each other. The rainy season of the Soudan is from July to September, when the sun is at its zenith north of the equator ; but the rainy season of the Zambesi valley is from December to the end of February—that is, when the sun is in its zenith south of the equator ; and this period is, therefore, the hot season of the south.

In Northern Africa : Egypt has a climate which is hot and dry ; a hot, dry wind, called the khamsin, blows from the desert in April and May. The summer rain begins in July and lasts till September, which causes the annual rise of the Nile and the productiveness of the surrounding countries. The westerly winds, which blow from the Atlantic, deposit most of their moisture upon the mountains of Algeria and Morocco, and arrive in Egypt dry ; the north-east trade winds, which blow from the land, also bring

very little rain. The water which flows down the Nile and inundates the country is chiefly derived from rains which fall in Abyssinia and districts further south, about the tributaries of the river. The rainfall is more abundant in the Soudan, and causes an abundant and luxuriant vegetation there.

In Western Africa, between the Senegal and Orange Rivers, the climate is very hot and moist, which makes the district unhealthy, owing to the prevalence of malarial and other fevers.

South Africa has a clear, dry atmosphere, and a climate which, on the whole, is fairly healthy. But fever is prevalent in Natal and parts of the Transvaal and Zambesi valley. The rainfall varies considerably, averaging 43 inches per annum at Durban, but only 2 inches at Port Nolloth. The most rain falls on the eastern side, because the trade winds blow from the ocean, and their rain is deposited on the eastern range of mountains; these winds are aided by the great heat of the interior, which causes an indraught of air. On the western coasts, however, the trade winds blow away from the land and have already lost their moisture in their journey across it. These winds meet with the western winds from the ocean, but as the latter blow from a cool to a warmer air, they are enabled to retain their moisture, and consequently bring little rain to the country. The rainy season is, in the eastern districts, from September to April. The rainfall increases towards the north, but diminishes towards the west. On the Great Karroo the rainfall averages only 9 inches per annum; towards the mouth of the Orange River the district is almost rainless; in the south-west district of Cape Colony the rain falls chiefly between April and October. The island of Madagascar, off the east coast of South Africa, has a similar climate to that of the mainland.

South America is very largely within the tropical zone, and has a tropical climate, with alternate hot and dry seasons. The position and height of the Andes influences the rainfall and the wind. In the northern region, the east trade wind prevails and brings a copious rain, but Brazil has a scanty rainfall, and Venezuela has severe drought in the dry season. The Argentine Republic has a sufficient rainfall and considerable warmth, and Paraguay has a climate and soil which are superb. Mean annual temperature is 75°, mean summer 83°, mean winter 60°, said to be free

from miasma, and remarkably suitable for the cultivation of maize; the climate of Uruguay is similar. In the southern portion north-west winds are prevalent, and the rain falls chiefly on the western slopes of the Andes, while the Pampas and steppes of Patagonia are dry. The extreme south has a disagreeable climate, with fog, rain, and cold winters.

Mexico and **Central America** are also chiefly within the tropics, but the greater portion of the land is of such an elevation that only a comparatively small portion has a tropical climate. This elevated plateau extends from the United States to Central America, and gradually falls from 7,500 feet in the Plateau of Anahuac to less than 1,000 feet in Panama. The climate varies in accordance with the elevation, being relatively cold on the higher parts for this region of the earth and temperate in the lower regions of the plateau; but in the coast region it is decidedly hot, and the land is swampy or marshy in many places. The prevailing winds are from the west, and the great height of the mountains causes rain to fall chiefly on the western slopes. There are alternate wet and dry seasons, but the rainfall is insufficient for agriculture over large areas, and irrigation is necessary to assist in this object.

The Southern States of North America are (some of them) subtropical, as Florida, Georgia, Alabama, South Carolina, Louisiana, Texas, New Mexico, Arizona, and Lower California.

Asia is a huge continent with groups of many islands. The tropical districts include India, Ceylon, Burma, Siam, the Malay Peninsula, Annam, Cochin China, South China, Formosa, the Philippines, Moluccas, Borneo, Java, Sumatra, the Straits Settlements, Polynesia, and many groups of islands in the Pacific and Indian Oceans; it is therefore impossible to deal with each one.

The group of islands forming the *Japanese Empire* are, with the exception of Formosa, entirely in the *temperate* zone. Their eastern shores are washed by the Japanese Ocean current, which, like the Gulf Stream, brings heat from the equatorial regions and warms the coasts which it washes; hence the eastern shores of Japan are warmer than the western; indeed, the latter may be very cold in winter, although in the same latitude as Northern Italy. The islands are mountainous; active volcanoes exist in some of them, and earthquakes are frequent but not very destruc-

tive. The rainfall at Tokio is 65 inches per annum, and is everywhere abundant. Formosa is warm all the year, the difference between the mean winter and mean summer temperatures being only 20° F.

The climate of *China* varies in proportion to the greatness of the area occupied. China proper has a fairly equable climate, but in the north-west there are extremes of heat and cold, and it is very dry; in the north a cold winter follows a warm summer, the Gulf of Petchili being frozen over. The temperature of Pekin averages 80° in July, but only 20° in January; it has therefore a great range of 60° F. The winter gets warmer as we travel further south, and in Southern China the difference between the mean temperature in summer and winter is only 20° F., and it is similar to that in Hong-Kong. China and Manchuria are well watered. The rainfall on the east coast averages 40 inches per annum, but, although it is abundant everywhere, it diminishes from south to north. Violent storms called **typhoons** occur in the China seas.

The climate of *Indo-China* (Burma, Siam, Annam, and the Malay Peninsula) is hot, moist, and unhealthy. A heavy rainfall is brought by the south-west monsoon, and vegetation is most luxuriant. That of the islands of the Malay Archipelago (Sumatra, Java, Borneo, New Guinea, the Moluccas, Philippines, Celebes, and many smaller islands) is likewise very hot and moist because they are in the torrid zone, and the south-west monsoon brings a heavy rainfall, which averages 75 inches per annum, while the mean annual temperature is over 80° F. The typhoons, or violent storms, of the China seas affect all the adjacent districts and islands.

The climate of *India* is as various as that of any other large area of the earth, but a large portion of it is tropical. Three seasons are observable throughout the territory: the **hot season** (March, April, and May), **rainy season** (June to October), **cool season** (November to end of February); but this division is not quite correct for all parts—*e.g.*, the rainfall is variable, and the rainy season does not occupy the same months everywhere. The wettest regions are the hill district of North-East India, the Kási Hills, and the Western Ghauts; but the valley of the Indus is dry over a very large area. The climatic conditions depend very

much upon the prevailing winds, which are called **monsoons**. The wind blows for six months from the south-west, and this is called the south-west monsoon. It is laden with moisture, and a heavy downfall occurs on the Western Ghauts, in the valley of the Ganges, and on the hills in North-Eastern India; but much of the intervening country lacks rain, because there are no hills to produce a condensation of the moisture; on the contrary, the great heat radiating from the surface of the earth helps the air to retain its moisture. The wind then blows for six months from north-east, and is called the north-east monsoon. It brings rain to the eastern coasts and districts, but the rainfall from it is far more uncertain in the affected regions than that due to the former. The rainy season in Southern India is July, August, and September.

The monsoons are of regular occurrence, although they appear at slightly different times in the regions affected. On the Malabar coast the south-west monsoon begins in the middle of April, and continues to blow until September, when it loses its violence; the north-east monsoon begins in the southern part of this coast about the end of October, but does not reach the northern until two weeks later. On the Coromandel coast the south-west monsoon begins in April, but does not blow strongly until June, and declines in September; the north-east monsoon begins about the middle of October. The direction of these winds is much influenced by the hills, the south-west monsoon being diverted from its course by the Himalayas and turned into a south-east wind blowing up the valley of the Ganges; and as it loses much of its moisture in travelling from the sea over so large an area of land, it deposits very little rain in North-West India, which, in consequence, is comparatively dry. The setting in of the monsoon is marked by storms of wind and rain on the Malabar coast, but the clouds thus driven along are diverted by the Western Ghauts, so that it is now the dry season on the Coromandel coast. The northern extremity of these mountains, however, allows the monsoon to carry the clouds, without check, all over the country. The eastern mountains, having a lower elevation and being at a greater distance from the sea, cause a smaller condensation of cloud and rain in their neighbourhood, owing to which reasons the rainy season in the Carnatic only

lasts two months, while in the Circars the wet season is much longer. The province of Coimbetoor has a similar rainy season to that of Malabar, owing to the lowness of the hills in that district. The *tebbad* is the native name for a searching hot wind which blows over Central Asia and its hot sandy plains, and carries clouds of impalpable dust which act like particles of fire on the skin.

The northern parts of Hindostan have a dry climate, because the monsoons do not extend further north than latitude 24° 44′. During the rainy season of the south the atmosphere is here generally cloudy, but little rain falls. In Scinde and the Punjab the rainfall is very small, and in Northern India generally the rains are less violent, but the cold is more intense and the heat greater. The crops of temperate climates are grown in the north-west, where the winter is about equal to the summer of Northern Europe. Bengal has a tropical climate and products. Two crops are produced: one in summer, another in winter. In the northern provinces of Cashmere, Nepal, Cabul, and Gurwal, above which tower the Himalayas, 'the natives of colder climates may enjoy the delights of a lengthened spring, a real winter, and the genial heat of a healthy summer.'

In Scinde the proximity of the deserts makes the air very dry and the heat excessive. The temperature in June and July ranges from 90° to 100°, but in the winter the temperature in Northern India drops to 30°, and water freezes. Equally great variations of temperature occur in Rajpootana, Delhi district, Oude, and as far down as Benares and Allahabad.

At Calcutta the temperature registers 110° in April, but it may fall to 72° at night; in December it may fall to 52° during the north-east monsoon. Madras has a lower temperature than Calcutta, the annual mean temperature being 80°; it seldom rises above 91° when it is hottest in July, and it may sink to about 75° in January, when it is coldest. The temperature of Bombay ranges from 64° to 100° throughout the year.

The soil of India, which of course influences the salubrity of the climate, presents variations in proportion to its area. The plains through which the Ganges runs have a black alluvial mould, but other parts of Bengal have a considerable extent of clay-loam, and so have the regions of the Punjab and Mysore. Near the coasts, and also in Scinde, Rajpootana, and Guzerat,

the soil is very sandy. The soil of the tableland of the Deccan and of the southern provinces consists largely of loam or rock. In Malabar, at the foot of the low hills, it is a reddish clay. The Coromandel coast has a sandy soil which reaches to the foot of the Eastern Ghauts, and is very barren. The subsoil of many parts of Hindostan proper is chalk and clay. The country is very fertile near the mouths and on the banks of rivers, where irrigation has been carried out, rich crops growing everywhere. Even in the dry season, when water is not easily obtained and Nature languishes, two or three days of rain will transform a scorched country or seemingly barren plain into a verdant and glorious picture.

LIFE IN THE TROPICS.

Every district presents a different climate, from its conjunction of mountain, sea, river, coast, jungle or sandy area, the flora and fauna, general elevation, and cultivated or uncultivated condition. But the great difference between the seasons in temperature, moisture, and electrical condition of the atmosphere is equally important in its effect upon the resident who is not a native of the country.

The *hot season* is the most healthy. Although the heat is very great and causes discomfort, the temperature is usually pretty equable, and the body is not subject to sudden changes, exposure to wind, damp, and chill, as at other times; neither are malarial exhalations so abundant. Those who have lived long in a tropical country, and whose skin has lost its functions to a great extent, enjoy better health at this time, because the increased temperature causes perspiration which relieves the roughness and dryness of the skin to which they are liable. Sunstroke and skin diseases are common at this season, also cholera in certain districts; and the heat often produces great debility, which renders the advent of the rainy season critical or even dangerous to such persons.

In the *rainy season* sudden changes of temperature occur, which, together with the excessive moisture of the atmosphere, tends to check the previous abundant evaporation from the body, in consequence of which the exuded perspiration streams copiously

over the cutaneous surface, whereby the skin is chilled, and a tendency to lower the vitality and to congestive maladies is very common amongst non-native residents. The diseases which are common at this time are: affections of the stomach, liver, and spleen, diarrhœa and dysentery. As the season advances, and the soil and marshy areas or pools begin to get dry, malaria is abundant and tropical fevers are prevalent in a very large number of districts.

The *cold season* is the most enjoyable period, especially to those newly arrived in the country, and for all persons of sound constitution, but it cannot always be regarded as the most healthy time for the sickly and delicate. For those with languid or feeble circulation and old residents this period is often fraught with discomfort and annoyance. People often suffer from dryness of the skin, burning of the hands and feet, and general irritability, which do not trouble them in the hot dry season. At this period fevers of an intermittent type prevail; coughs, colds, and chest diseases are common; the liver and bowels are disordered; but the kidneys usually act vigorously and make up for the absence of perspiration by the excretion of a large amount of pale, limpid urine.

The best time to arrive is undoubtedly the cold season or its commencement; for although this period is spoken of as being less healthy than its opposite, new arrivals enjoy better health then, and it enables them to become gradually inured to the heat of a tropical summer.

Acclimatization.—It used to be thought that a protracted residence in a hot climate would enable a person to get accustomed to its influences. But no matter how many years a man lives in the tropics, his best health is usually during the first few months or years of his residence; so that in the sense of being hardened to malaria and climatic influence, acclimatization is no longer believed in. But a person who is long resident in the tropics may acquire a partial immunity to malaria. The new resident may have a good deal of fever of one type or another, but in a year or two he may be afflicted less violently, or he may only have a milder type and at longer intervals. There is, however, ample proof that in many cases the health begins to deteriorate from the very commencement of his life in the tropics.

Long residence within the torrid zone gradually changes the constitution, and is adverse to the health of many non-natives. The exposure to heat and malaria, and the generally different mode of life, results in a state of debility or cachexia in which low forms of disease are very common, and it is necessary to husband the strength in every possible manner. Little items which one would laugh at in temperate regions often assume in the tropics an importance far out of their apparent value. For instance, the heat causes an increased secretion of perspiration by the skin, and diminished excretion of urine by the kidneys; whence it follows that, if the skin be suddenly chilled, the waste materials of the body are thrown back upon the liver and kidneys, and congestion of the liver or kidneys results. The respiration and pulse are quickened by the heat; the blood-forming organs suffer and anæmia occurs; the brain and nervous system, first excited by the change of climate, becomes depressed after some months of residence. The individual loses weight and strength and becomes cachectic, by reason of which a more stimulating treatment of illness is frequently required than would be necessary for the same persons in their native climate, or would be necessary in newly-arrived, robust, and plethoric persons; just as the well-fed European does not require that amount of stimulation which is found necessary for the anæmic inhabitants of large towns. This condition of cachexia is not so quickly developed in some constitutions as others. Vigorous and robust persons are seen who have long resided in India, Africa, South America, the West Indies, and other tropical countries; but an inquiry as to how many of the companions of their earlier days of residence have been able to stand it shows how very few are acclimatized. The chief causes are that sufficient care is not taken in the selection of people sent out, that they are not protected when they arrive from the evil influences of the climate, that the climate of the district has not been sufficiently studied; but equally important are the effects of intemperance, carelessness in diet, and malaria. Much has been done in the past generation to diminish the effects of climate in most of the districts where men go upon military service, for purposes of commerce, mining, or the development of the country; and an infinite benefit will accrue from recent knowledge of the causes of malaria and means

taken to check it, but much remains to be done by each individual with regard to personal hygiene. There are many people who possess a naturally feeble constitution and can never long sustain a residence in hot countries; but if they are able to make their health a study, and have command over the best things at their disposal, they may be able to stand it much longer than without such consideration. Much, indeed, can be done by careful dieting, daily bathing, and exercise, and by avoiding exposure to the excessive heat of middle day or the mists of night. It may be stated generally that persons of badly-formed physique, narrow chests, large joints, or of a phlegmatic or lymphatic temperament, ought not to go at all; and persons who have long been insufficiently fed and clothed, who have not had proper out-of-door exercise or fresh air and sunlight, as with many of the poorer denizens of large towns and cities, or who have well-marked signs of scrofula or struma, are not fit subjects for a tropical climate until their health has been improved and their constitution built up.

The individual resident of the tropics must attend to his own personal hygiene. He must not pursue the same course of living which he did at home. For instance, he should somewhat reduce the consumption of animal food, of wine and spirits. On the contrary, many young men take a larger amount of animal and other rich foods, besides ale, wine, or spirits, than they ever did at home; and this, combined with the excitement, novelty of scenery and customs, heat and dust, or moist and malarial atmosphere, soon renders them *hors de combat*, or provides an inroad for one of the many chronic ailments which creep insidiously upon the non-native resident of the tropics. It is necessary, above all, to keep in order the functions of the skin, liver, and kidneys—those organs which are chiefly concerned in ridding the system of waste materials. For the skin, nothing is more important than daily washing the body in cold water, sponging it freely, and drying it carefully. Cleanliness is even more essential than in the cooler regions of the earth, because of the unpleasant perspiration. Great sweating of the hands, feet, groins, genitals, and armpits is very common in the hot season, and is *increased by excesses* in eating and drinking. A cold or tepid bath is the best; only the robust should bathe in rivers, lakes, or the sea,

and none are advised to do so in mountain streams, because the water is too cold. Out-of-door bathing should not be taken during the heat of the day, nor before the sun is well up (say 8 a.m.). Many attacks of illness are due to injudicious bathing. It may induce **cramp** (which may be relieved by vigorous movement of the limb, or rubbing it towards the heart with a rough towel), and a long swim may induce severe exhaustion or failure of the heart. Many natives are much troubled by **vermin**, and when used as servants the non-native resident is liable to become affected by the same from occasional personal contact with them, or with articles they have handled. Lice, fleas, and bugs are very common, but may be destroyed by the use of carbolic or other disinfectant solutions, and by boiling the clothing. The chigger is a flea, smaller than the common one, which is troublesome to the residents in America, Africa, and other hot countries. It lives on the ground in sand or grass, and affects domestic animals, whence it gets to man, and the female insect burrows in his skin, and causes a painful swelling about as big as a pea, which often suppurates. The itch is due to another female insect, which penetrates the skin to lay eggs, and is best treated by sulphur lotions and boiling the clothes. Maggots in the skin are due to another kind of insect, found in houses, on animals, and on the leaves and fruit of bananas. The larva is about the size of a flea, and penetrates the skin of human beings, where it grows for weeks and causes a stinging sensation, usually followed by a boil, which should be opened. Africans call this **ifwingire. Prickly heat** is another troublesome ailment of the skin, due to a congestion of the sweat-glands, which causes the skin to feel rough and dry, and covered with red papules. It occurs mostly in hot, moist months, and it itches horribly. It may be relieved by bathing the skin with vinegar and water or an alkaline wash, taking an aperient and temperate diet, and wearing light linen clothing or underclothing. But no remedy is of much avail if the person persists in drinking very much fluid of any kind, and it often occurs after a too liberal diet. Boils, nettle-rash, and erythema, or inflammatory redness of the skin of the arms, legs, or neck, often occurs from undue exposure of these parts to the sun. Soda or other alkaline wash with a light diet usually relieves them.

The Clothing.—The power which man has over his clothing materially assists him in protecting his body from the effects of climate. The temperature of the atmosphere in the tropics is often greater than that of the human body for months together, which causes a greater circulation of blood through the skin, and a large evaporation of moisture from it in the form of perspiration. Clothing is needed in the tropics, therefore, not to keep the body warm exactly, but to protect it from the solar heat. At the same time, the non-native resident in the tropics should be so clothed as to prevent sudden chilling of his body, which may readily occur in spite of the heat. Absolutely the best dress for this purpose consists of a fine *flannel garment next to the skin* worn day and night, over which other clothing may be worn according to the season. Some persons prefer a mixture of silk and wool or cotton and wool for combinations or shirts and drawers. Stockings should consist of cashmere, silk, or cotton for the hot season, but woollen ones will be necessary if much marching has to be done. If the wearing of flannel causes prickly heat, a thin cotton or silk vest may be worn under it; but flannel is essential. When travelling in a hill district, or cooler region than the usual place of residence, extra flannel should be worn; and when standing out of doors for a few minutes after walking or other exercise extra clothing should be worn. *The upper garments* may consist of many kinds of material, but cotton, linen, muslin, or silk are the best. White is, of course, the colour which absorbs the least heat, and is, therefore, the most suitable. **White drill**, linen, cotton, or flannel tennis-shirts are usually worn. Cotton is admirable, except when the body is bathed in perspiration, which it absorbs readily and retains. Linen does not absorb moisture so readily, is colder, but does not soil so easily. The belt, or **kamarband**, is necessary, should be of flannel, about 10 inches broad, and should be worn loosely round the body. Sleeping-suits should consist of flannel or other woollen material. The early part of the night may be so hot that no bedclothing can be used; but the middle of the night or early morning is often so chilly as to endanger the person who is not properly protected. Boots or shoes should be of soft and pliable material, have an inner sole of cork or asbestos, fit well, and yet be roomy. The legs must be properly protected when out

walking or riding, for which purpose **putties** are preferable to leggings. No part of a man's clothing is more important than his head-gear. This should consist of a good light pith helmet or straw hat, well ventilated, shading his eyes in front and protecting his neck behind. It is advisable never to go out of doors into the direct rays of the sun without such a protection upon the head, to avoid sunstroke or other ailments. Everybody ought to be provided with a **mosquito-net**. We know now that the unpleasant irritation and swelling which follows a puncture of the skin by one of these insects is the least injury they inflict, for they frequently infect the bitten person with fever; wherefore a good mosquito-net is of immense value to all who live where such insects exist.

Exercise.—The continuance of health depends largely upon taking regular physical exercise during the cool of the day, and this exercise should be as much as the season will permit, avoiding undue exposure to the sun. The tendency in the tropics is to lead a sedentary life on account of the heat, which is entirely wrong, because it is so much more injurious than a sedentary life in the temperate regions. Exercise *must* be taken, and the tendency not to take it must be rigorously fought if the health is to be maintained. The resident should avail himself of whatever is offered in the way of recreation and amusement—bowls, quoits, cricket, tennis, rowing, jumping, shooting, theatricals — but lounging and apathy must be discouraged. Ennui drives many men to intemperance and venereal excesses, with their subsequent ailments, which, like other diseases, are troublesome to treat in proportion to bodily debility. Early morning is the best time for outdoor games and exercises, when the air is cool and balmy and the body fresh and able to endure activity. Walking or riding before the morning bath is excellent. It is recommended that all journeys should be begun by 6 a.m., and ended before noon for that day.

The importance of a due amount of **sleep** for every human being has never been disputed, nor that the proper time for repose is during the hours of darkness. Important as this may be in the temperate regions of the earth, it is far more important for the denizens of hot countries. No amount of sleep in the daytime can compensate for the loss of sleep at night, because

the conditions are never the same—the disturbances from noise, the heat, light, and dust, are such as to prevent perfect repose, and the sleep is not so refreshing to the nervous system. The total daily amount of sleep should average ten hours, of which one and a half or two hours may be occupied in the siesta or noonday rest, which is almost universal in hot countries.

The Site for a House.—It has always been regarded as important to choose a proper site for a house even in temperate regions; but this is of more importance to the white man when living in the tropics than elsewhere, because of the danger from malaria and the other evils pertaining to the soil, which have an exaggerated importance. Nevertheless, the same principles guide us in that selection as elsewhere. The house should be built on an elevated and dry area, as the declivity of a hill, an elevated bank of a river if it has a slope each way, or a tongue of land running seaward. Drained and cultivated land is the best, with a subsoil of granite or other rock from which the water soon drains away. Clay-slate or shale, limestone, chalk, or gravel and sand, if of good depth, are good sites for a house. But bad sites are chalk or sand with an under layer of clay, which is very liable to be cold, damp, and malarious, also the low banks of lakes or rivers, the dried bed of a river, clay soil, marshes, or the lee-side of marshes, gorges, and jungle. Wet, damp, or swampy regions, and uncultivated ground with damp or porous soil and rank vegetation, are factors which assist in the causation of malarial diseases, and are otherwise unhealthy. The importance of draining swampy ground and of clearing jungles of all deciduous vegetation, especially when they exist in the neighbourhood of a settlement, cannot be questioned, for if this be not done the best site may be rendered unhealthy by their proximity, whereas a malarious locality is rendered healthy by this means. When going to live in a country district, therefore, it is proper to drain all swampy ground near to where the house must be, to fill up all hollows, and clear the jungle or neighbouring wood of all vegetation which deposits its leaves freely, to leave nothing but shrubs or trees which can be lopped underneath to about 6 feet above the ground. The luxuriant growth of vegetation and its decay in the neighbourhood of residences in all tropical and subtropical climates is one of the chief items in the production

of unhealthy areas; the miasma arises largely from decomposing organic matter, and is always more abundant and powerful near the earth.

The house should consist of two stories—at any rate, the sleeping apartments should not be lower than 8 or 10 feet above the ground. Sleeping upon the ground or near it must be avoided because of the danger from malaria; elevation of the bedroom 8 or 10 feet will make it cooler, more conducive to sleep, and freer from mosquitoes, which do not so often visit an elevated and breezy room as they do apartments which are nearer the ground and are not so well ventilated. The ventilation of the house is exceedingly important, but this must be as free as possible from *draught*, which must also be guarded against by the use of screens, for it weakens the body and renders it a ready prey to disease; nevertheless, a plentiful supply of fresh air must be obtained throughout the house. The ground floor of the house ought to be made impervious by cement, concrete, or plaster; and the walls thereof should *not* be made of sun-dried bricks, as the latter have sometimes been responsible for fever and death, but the house should be built of burnt-brick, stone, or wood. A veranda should be provided to each house, and there should be proper spouting to carry away the rain which falls upon the roof, lest the ground about the house become a quagmire or forms pools for the breeding of mosquitoes and malaria. It is better to have a fire in the rooms every day in a moist climate, whether required for warmth or not; it keeps the rooms dry, and is an important aid to ventilation. A fire on the veranda at night is said to be a good protection against malaria.

Residence on a hill or on an elevated site removes one from the debilitating effects of the heat of lowlands, and places him in a healthier climate, which is important to those who have suffered from the effects of living in valleys or on the plains. The advantages of a hill climate are the elevation above the hot stratum of air which passes like a fiery furnace over the plains in the hot season, better sleep owing to cooler air, less intense forms of malaria, freedom from cholera in many districts, and the possibility of a greater amount of exercise, with a maximum of health and physical comfort. There are disadvantages, such

as a greater degree of cold in the cold season, more fog and damp in the wet season, diphtheria, typhus, cholera, and plague in certain tropical climates. It is usually regarded that an elevation of 4,000 feet is a sufficient height for the residents of the plains to ascend in search of health in the tropical mountains; here they have most of the advantages. Yellow fever does not ascend above 2,500 feet, but malaria is seen as high as 7,000 feet, as in the Himalayas, perhaps because of local peculiarities, as a swampy area or a loose and porous soil, which are liable to occur in hill districts. There are, however, admirable stations in the Himalayas, the Neilgherries, and hills in other tropical countries, where there is no fever and cholera never penetrates. A residence of three months in the hills during the hot season braces the system, lassitude disappears, calm sleep is obtained, and the individual escapes the effects of poison in the atmosphere at a lower region.

Seaside or coast resorts are very useful as restoratives for those long resident in tropical regions, or who are suffering from diseases of the liver or spleen or dysentery, when sea-coast is preferable to mountain resorts. Here the heat is tempered by a sea-breeze, the nights are cool, and a tonic influence is brought about. It is better if the house is on a cliff, and one jutting into the sea is the best, at the base of which there is always water; or, at any rate, clean sand or shingle at low tide. A neck of land may be chosen, but there should always be ocean in front, and the surrounding country should be well drained and free from marsh and jungle.

FOOD.

Food in relation to hot climates has already been discussed in the chapter on 'Food for Adults' (*q.v.*). The pith of those recommendations is that somewhat less animal food and somewhat more carbohydrate, such as bread, oatmeal, and potatoes, should be taken than in the average or normal diet; that plenty of green vegetables and fruit should be eaten; that it is better not to eat a heavy meal in the middle of the day, nor to go to sleep immediately after a heavy meal. Dinner is better eaten after the work of the day is over. We may, however, venture to dilate upon this a little more. The individual makes a voyage, perhaps

of some weeks' duration, on a vessel upon which an abundance of food and but little exercise can be taken ; he eats well because the sea air gives him a supernormal appetite, and he arrives at his destination with his system overloaded, and perhaps in the hot season—if so, he is almost certain to have an attack of bilious diarrhœa, congestion of the liver, a crop of boils, or the prickly heat. Bilious diarrhœa is Nature's way to unload the system of undesirable material, but it may pass into the more serious forms of diarrhœa or dysentery, or, if the congested liver is neglected, it may become acutely inflamed, or terminate in liver abscess or chronic liver trouble. Such evils threaten all newcomers during the first few months, during which period a healthy plethoric person will do well to abstain from all stimulants, and adopt a dietary in which vegetables and fruit are prominent items and animal food forms a smaller part than usual ; for if the evil effects of alcohol or the habitual use of hot and highly-spiced dishes be added to the excitement of the system which is due to the change of climate, it may safely be asserted that the liver will become seriously damaged and the health and comfort destroyed. After a short residence, complete abstinence from alcohol is not absolutely recommended—indeed, there are many people to whom complete abstinence is as prejudicial as the opposite—although it is known to all large employers of men, in hot countries especially, that most work is to be got out of those who never drink at all or are exceedingly abstemious ; whereas much drink, besides affecting the stomach and liver much more than it does in temperate regions, causes headache, mental irritability, and inability to bear fatigue, and perhaps liability to sunstroke and even malaria.

During residence in foreign countries, campaigns by land or sea, it is important that fresh food should be given out as long as possible. There is, however, sometimes a shortage of the customary kinds of food, and resort is then had to dried or salted or tinned meat, meat biscuits, preserved vegetables, concentrated foods, water-free foods, and others, such as pemmican. This, however, is not quite as it should be : fresh food is extremely necessary because of the great tendency to anæmia, scurvy, skin diseases, disease of the liver and stomach, and cachexia loci. There are many native animals and vegetables quite as suitable

for food as those to which the new resident has been previously accustomed, and it is from these that he must draw his supplies of fresh food.

The domestic animals, cattle, sheep, goats, pigs, and poultry, are bred in most places where the white man has long been domiciled, but there are many regions where fresh meat of the ordinary kinds is not obtainable. The importance of fresh food is, however, so great that hunting, shooting, and fishing are sports which are strongly recommended, not only for exercise, but from the point of view of maintaining health through the food by obtaining it in a perfectly fresh condition. In Africa, for instance, there is an abundance of animals which serve for fresh food for man, and none need really live long upon dried or salted meat if only time and ammunition may be had. Antelope is equal to venison; hippopotamus flesh resembles pork, and is said to be excellent; giraffe is like young beef or veal; quagga and zebra are also similar to beef; and there is an abundance of fish in the streams. It may therefore be of interest if some notes are here added upon the geographical distribution of certain animals or groups of animals and vegetables suitable for food.

Bovine animals, or oxen, are cultivated in most places where civilized man has been long domiciled, many breeds having been imported from Europe, and native varieties exist in a large number of places. Special forms should, however, be mentioned, as the buffalo or bison of America, two species of buffalo in Africa (Cape buffalo), the arnee of India, the ghaurs or wild cattle, and the yak or wild oxen, of the high plateaus of Thibet, the Himalayas, and extending southwards. Their flesh, though nutritious, is like coarse beef, and not very highly esteemed. The zebu is of the ox tribe; it is found extensively in India, China, North Africa, and other places. The flesh is highly esteemed, the hump being considered a great delicacy. The musk-ox of North America is a bovine animal, whose flesh is pleasant to eat, but smells of musk. The aoudad of North Africa is a bovine animal which inhabits the mountainous regions; it is allied to sheep, and most nearly to the moufflon and argali.

Sheep and goats are almost exclusively Old World animals, with only two native representatives in America—the argali or Rocky Mountain sheep, which is also found in Asia, and the

musk-ox of Arctic North America. Sheep of various breeds are cultivated wherever civilized man exists. Wild ones are found in the mountains of Corsica, Sardinia, Crete, Greece, Asia Minor, Persia, Central and North-Eastern Asia, particular species being the **moufflon** in the European places just named, and the **merino** in Spain and other places of Southern Europe. **Goats** are found from Southern Europe or Spain to the Caucasus, whence they extend through Armenia and Persia to the Himalayas and China. The waryato of the Neilgherries is a special variety.

The Deer Family is widely extended. Stags are distributed over the Old and New World ; but Australia is entirely deficient, and Africa has only two species—the fallow deer and a stag. America has also only a very limited representation of the deer family. The **stag**, or red deer, extends throughout all Europe and Northern Asia ; the **fallow deer** or **dama** in Europe, Asia, and West Africa ; the **roebuck** over most of Europe and parts of Asia as far as China ; the **reindeer** through Northern Europe and Asia ; the **cariboo** of North America is similar, but not identical ; the **elk**, varieties of which are **moose-deer and alces**, is about the size of a horse ; it extends through the colder parts of North America, Russia, Poland, Sweden, and Norway. Various kinds which bear local characters are the **rusa**, which is a species of deer in the forests of India and islands of the Malay Archipelago ; the **sambur** is similar to it, and occupies the forests and mountains of Northern India. The **musk-deer** also occurs in Asia, and various small animals in the Asiatic islands bear the same name. South America has several species, and one extends from Canada to Mexico, besides which there is the **Canadian stag** or wapiti. The ibex, which resembles the deer, inhabits the Alpine peaks of Switzerland, the Apennines, the Pyrenees, Egypt, Syria, Abyssinia, and the Caucasus.

The Antelopes are a large and numerous family, which are spread over a large part of the earth, especially in warm countries, and appear to be most numerous where the deer family is absent or scantily represented. Their flesh is considered to be quite equal to venison, and is eaten roast, boiled, or in soup. There are two chief species in Europe—the **chamois**, which, however, extends from the Pyrenees to the mountains of the Caucasus ; and the **saiga**, in the hilly districts of Eastern Europe and Asiatic

countries adjoining. In India there is the common antelope or **sasin**, besides the **chikara** and **nylghau**, which extend into China, Japan, Formosa, and the Malay Archipelago; and there are two or three species on the Thibetan plateau. America has the prong-buck or cabrit, which, together with the Rocky Mountain sheep or argali, is threatened with extinction. They are particularly abundant in Africa, where numerous related families occur, and are known by the names of harte-beste, spring-bok, bush-bok, blue-buck, bles-bok, impoon, kob, kevel, koodoo, eland, gnu, gazelle, etc.

The Camel tribe, including the llama, alpaca, vicuna, and guanaco, inhabits Central and Southern America and the West Indies and Africa. The **alpaca** (*Alpaca paco*) is a native of the Andes, in Chili and Peru. It is about the size of a sheep, is closely allied to the llama, and, like it, has flesh which is wholesome and agreeable.

Horse-flesh is everywhere used for food in times of scarcity, and regularly by some people; also the varieties zebra and quagga.

The Hog Family.—Ordinary swine are bred in many places, and native varieties occur in India, Africa, etc. The true swine or common hog extends over temperate Europe and Asia. The Indian horned-hog or babyrussa is not found in the continents of Asia or Africa, but in the islands of the Indian Archipelago. The wart-hog and the river-hog are subgenera found in North and South Africa, in Java, and Celebes; and several other species extending from Japan to Africa have well-favoured flesh which is eaten for food. The **peccary** is a small hog-like animal of South America, having flesh which is similar to pork.

Rhinoceros, of which there are five species in Cape Colony, South Africa, Bengal, and a considerable part of Asia, have flesh which is not despised for food; and there are two species of **hippopotamus** in Africa, and a third in Madagascar, whose flesh is eaten with great relish and is compared to pork.

The Badger is a plantigrade animal of Central Europe and Asia as far as China, Hong-Kong, and Japan, and also in America. It is as big as a fair-sized dog. Its flesh is eaten as pork and makes good bacon. **Raccoon** (*Procyon lotor*) is another plantigrade animal, about the size of a fox, which lives in America from Canada to the tropics, and its flesh is palatable food. The **aswail**

or sloth-bear (*Ursus labiatus*) of the mountains of India is also related, and has flesh which is in high favour as food.

Hares and Rabbits are almost exclusively confined to North America, North Africa, and Eur-Asia; they extend northwards to the Arctic regions. Rabbits were introduced into Australia, and are now very prevalent. In Central and South America and the West Indies they are replaced by other rodents such as the agouti, cavy, capybara, paca, and coypou. The coypou is a rodent 2 or 3 feet long, which lives in Chili. It is chiefly valued for its fur. There are many species of cavies or guinea-pigs in South America—as the agouti or yellow cavy, which is about the size of a rabbit; and the paca, which is about as big as a dog, fat, and highly esteemed for food. The capybara is the largest cavy, and is about 3 feet long. The flesh of all these animals is white, well flavoured, and much thought of for food. The animals are pursued as game. **Porcupines** are sometimes eaten in Italy, Africa, Asia, and America. **Rats** are also consumed, and the **bandicoot** (*Mus giganteus*), the largest known rat, has delicate flesh, which resembles pork, and is a favourite article of diet among the natives of India and Ceylon, where they are abundant. **Hedgehogs** are also eaten. They are found in most of Europe, the greater part of Africa, Asia, and the Malay Archipelago.

Amongst **edentata** the armadillo is esteemed good food in Central and Southern America, and the aard-vark or earth-pig in South Africa. The marsupials, including the kangaroo, kangaroo-rat, and opossum, are eaten in Australia and New Guinea. Kangaroo eats like venison, but is sometimes very tough; kangaroo-rat like rabbit or hare; and they are used in making soup, which is highly nourishing and stimulating. The opossum is a fœtid animal, but its flesh is nutritious and pleasant. The true opossum only exists in America, but there is a very similar animal which is called by that name in Australia. Amongst oceanic mammalia, the porpoise, boiled, roasted, or fried, has long been used by sailors, when they have been for a long time on salted meat; it is found in the North Atlantic Ocean. Dugong is another mammal of the Indian seas whose flesh is eaten; it is tender, and considered to be not unlike beef. Manatee or sea-cow, which lives on the American and African coasts, is similar, the flesh being of a flavour between veal and pork.

The eggs and flesh of birds are used for food all over the world. The domestic fowls are bred in nearly every habitable region, as well as turkeys, guinea-fowl, pea-fowl, and pigeons. The jungle-fowl of India, of which numerous species are abundant throughout the peninsula, is probably the original of the domestic fowl. Turkeys and bustards or wild turkeys occur in every continent, and many of the West Indian and Pacific islands. Guinea-fowls are natives of Africa, but are cultivated or found wild in many other places. Peacock or pea-fowls are found throughout Southern Asia from the Himalayas to Ceylon, and as far east as China, and they are cultivated in many places. Pheasants, natives of Southern Asia, are found in all temperate and most warm regions of the Old World; there are many species in warm climates, such as the argus, impeyan, and tragapan. Partridges exist in Europe, North Africa, and West Asia; grouse in Northern Europe and Asia, and there are many species in North America. The ptarmigan exists in Northern Europe and America, and in Arctic regions. Wood-grouse, called capercailzie in Scotland, one of the largest gallinaceous birds, is found in North Britain, Norway, Sweden, and North Europe generally. Quails are found in nearly every part of the globe. Tinamou, birds of South America, vary in size from a quail to a pheasant, and have white, delicate flesh, pleasant to eat. The attagas of Central Asia resembles a pheasant, but is allied to grouse and partridges. The prairie-hen of America is a grouse, much esteemed for food. The woodcock is found in all parts of Europe, Asia, and America. The curassow of America is related to the turkey, and the mound-builders or brush-turkeys, which are similar, are found in Australia and the Pacific islands. Many varieties of the domestic ducks and geese are cultivated in numerous places, and wild water-fowl are abundant in many places. Grebe, or the water-fowl, has a very wide distribution; the water-rail or marsh-hen is found in Europe, America, and West Indies. Coot is the name of a water-fowl common in India, China, Japan, America, and South Europe. Teal is a name applied to several small ducks, common to Europe and North America. The mallard or wild duck (*Anas boschus*) is abundant in Europe, Asia, and America; and the widgeon (*Mareca penelope*) in Europe and America, being very plentiful in Carolina. The heron or still-bird is highly prized for food by some people,

and is found in temperate and warm regions of Europe, America, and Australia. Sea-birds, such as the shag or cormorant, Mother Carey's chickens, the scoter, eider, garrot, scaup, and penguin, besides others, are eaten, and are to be preferred to a continuance of salt or dried meat.

Turtles and tortoises of many varieties are very abundant in the seas and shores of all warm climates, but rapidly diminish as we pass into the north or south temperate zones; their flesh and eggs are excellent food. The green turtle (*Chelonia mydas vel viridis*) is the one most highly esteemed as an article of food; it is considered a luxury in Europe. It is found over a considerable range, but is very rarely discovered on English or Mediterranean coasts. **Terrapins** are tortoises of warm, temperate, and tropical regions; many species in America are consumed as food. By far the greatest number of lizards are confined to the warm regions of the earth; of these, the **iguana**, of tropical America, Mexico, and the West Indies, is considered a delicate article of food; the **agama** is its representative in Africa, Asia, the Indian Archipelago, and parts of Australia, and, like the former, is eaten by many people. The **amblyrrynchus** is the only marine lizard known to exist, and is found on the coasts of Galapogos Island; it is 3 or 4 feet long, and its flesh is highly esteemed for food.

The most broadly diffused amphibian which is consumed by man is the green or edible frog (*Rana esculenta*); it extends from England to Scandinavia, and from Northern Africa through Central Asia to China and Japan. In America, the **axolotl**, a batrachian of the Mexican lakes, is considered a great luxury.

Fresh-water fish is usually abundant wherever there are rivers and lakes, and is particularly so in the northern hemisphere; but it is not so plentiful in Africa and Australia, where only about fifty fresh-water species are known, as in the other continents. Salmon is both a marine and fresh-water fish, and is found chiefly in the northern portions of Europe, Asia, and America; the white-fish of the North American lakes (*Coregonus sapidus*) is highly esteemed, and belongs to the salmon family (the name, however, is commonly applied in America to other fish, such as whiting and haddock, which do not belong to the species). Salmon-trout ranks next to salmon in form and colour, and occupies the same regions; trout are found in the rivers and

lakes of Europe, America, and Asia; various species of char in England and Northern Europe; and grayling in clear, rapid streams of the same area. The chromides and wrasses, which are allied, are found in the fresh waters of all hot countries; they are good eating, especially a species of the chromides found in the Nile. The pikes and perches are found in all temperate parts of Europe. The carp family includes carp, roach, tench, bream, loach, dace, bleak, barbel, and gudgeon, which are found in all European rivers and lakes, and in many warm regions. The sturgeon and sterlet exist in the large rivers of Europe.

The salmon family are found in most lakes and streams of elevated regions up to the line of perpetual snow both in Europe and Asia, and probably in all regions of the earth. Loach is found in the Himalayas and Andes at about 14,000 feet. Identical species of salmon, perch, burbot, and pike inhabit alike the waters of Europe and east of North America; perch exists in the Ganges and other rivers of East India and in the waters of New Zealand and Australia; and trout in the streams of Falkland, Tasmania, New Zealand, and South America.

Of shore and sea fishes, the cod fish family, including cod, hake, haddock, whiting; the mackerel family, including mackerel, tunny, ling, dory, mullet; the herring family—herring, shad, sprat, sardine, pilchard; and the flat fishes—sole, plaice, dab, brill, turbot, halibut, flounder—all occupy the northern temperate seas, and are fairly identical in the Atlantic and Pacific Oceans. On the British, Western European, and American east coasts there are, besides others, cod, hake, ling, bass, sea-perch, bull-head, herring, smelt, ray, conger; and, more rarely, the mullet, bream, and John Dory. The flat fishes begin in the northern regions, but increase in number in the Mediterranean and warmer seas; the codfish family diminishes correspondingly. There is a remarkable correspondence between the fishes of the Mediterranean shores and those of Japan and the eastern shores of Asia. In the south temperate zone, also, there is a close relationship between the fishes of that region and those of the north temperate zone, although there are very distinct species in the intermediate regions. The cod fish family is absent from Australian waters, but is represented by six species around New Zealand. In the equatorial regions the flat fish and herring

families are among the chief genera represented, but there are others peculiar to the region. Among the sea fishes the cod family are very important, especially in the seas of the northern hemisphere. The herring family extends through the equatorial region: herrings extend from Kamtschatka in the north to Central America; sprats abound in the North Atlantic and Mediterranean; sardines in the Mediterranean and warm temperate regions; anchovies also in the Mediterranean and all tropical seas. The mackerel family are in all European seas, and some of them in the Mediterranean and warmer seas. The flat fishes extend from the North Atlantic and Baltic Seas, increasing towards the equator, but the cod family diminishes as they increase. The fishes of the Atlantic and Indo-Pacific basins agree in similarity of genera and species. There are in nearly all regions varieties and species of fish which have a local habitation and reputation. Such are the white-fish (Coregonus) of America, which is esteemed by many to be the finest of all fishes; *namaycush*, of the salmon family, which is in the great lakes and rivers of America, and weighs 20 to 40 pounds, is much esteemed; candle-fish, also of the Salmonidæ, is rich in fat, and lives in shoals off North-West America; the black-fish or tantag, which weighs 12 or 14 pounds, is found off the New England coast and in Australia; the caplin is a smaller fish of the Salmonidæ, 6 or 7 inches long, like a smelt in form and colour, but it is of delicate flavour, and is found off North America and in all cold regions. Wolf-fish is abundant in northern countries, as Norway and Iceland, and is largely eaten; and mango-fish is found in the rivers of India, and is esteemed a great delicacy in April and May.

Lobster, crayfish, crabs, and other Crustacea are found in numbers over a large area from Norway to the tropics, some of them being particularly abundant in the warm seas. Caramote is a species of large shrimp, caught in great numbers in the Mediterranean, and salted for exportation. Shell-fish (Mollusca) also extend over the greater part of the earth. Some of them have great renown for their delicacy and nutritiveness—oysters, mussels, whelks, and especially clam, which is much used for making a nutritive and stimulating soup. The common clam of the United States is *Mya arenaria;* the giant clam is *Tridacna*

gigas. The edible snail (*Helix pomatia*), also called escargot, has a high reputation in France and Southern Europe for its nutritive qualities, and it contains a large amount of nitrogenous matters, which give it a deservedly high rank. Several of the Echimodernata are also eaten, and hold a high place among the luxuries of various people. The **trepang** or sea-cucumbers, which are of this order, are much sought after by the Chinese for food. They are dried in the sun and used for making soup. They are obtained chiefly from the Indian Ocean, the islands of the Malay Archipelago, Polynesia, and Australia.

Grouping various places together according to climate, we find—

(*a*) In Europe and Asia, as far as India—the Eur-Asian region —the domestic animals are all cultivated. In most districts varieties of cattle, sheep, goats, and pig are obtainable for food. The deer family are fairly abundant, and comprise the roebuck, stag, the fallow deer, and various others, which extend from South Europe to Asia and China. The stag ranges over nearly all Europe, and eastward in Asia as far as Lake Baikal and the river Lena. Goats are found from Spain to the Caucasus, whence they pass through Armenia and Persia to the Himalayas and China. The waryato of the Neilgherries is a special kind. The moufflon of the Mediterranean islands and mountains of Greece and Persia is a kind of sheep. Other sheep are found wild in the mountains of Corsica, Crete, Sardinia, Asia Minor, Persia, and Central and North-Eastern Asia. The merino is found in Spain. Wild cattle are found in many places, as the ghaurs, arnee, and Zebu of India and Yak of the Thibetan plateau. The aurochs or bison is now only found in Lithuania. The antelopes are not so abundant as deer, but the chamois extends from the Pyrenees to the Caucasus and the Saiga through Russia and Western Asia. There are also other goat-like forms which extend from the Eastern Himalayas to China and Japan. The hog extends over Europe and Asia, and various local varieties exist. The badger is found throughout Central Europe and Asia, as far as China and Japan. The birds are mostly those found in Europe—domestic fowls, turkeys, pigeons, pheasants, partridges, grouse, quail, pea-fowl, jungle fowl. China is properly the home of the pheasants, and in Japan the birds are similar to the European.

(*b*) The Oriental realm includes Southern India, Southern

China, Burmah, Siam, Annam, Formosa, the Malay Archipelago, Ceylon, Sumatra, Java, Borneo, the Philippines, New Guinea, and numerous smaller islands. Oxen are here represented by the Indian buffalo, which as a domestic animal ranges as far as Southern Europe; wild cattle, such as the ghaurs and gayal, which extend from Java to the Indian peninsula, and the zebu or sacred bull. Sheep are entirely wanting, except such as have been introduced by man. Goats have only one native representative, the waryato. Antelopes are not very numerous. They comprise the true antelope, the gazelle, nylghau, chikara, and two or three others. Their place is largely taken by deer, of which there are twenty species, varying in size from the diminutive muntjac to the giant rusa. Badgers are common, and, together with the aswail or sloth-bear, are among the animals consumed for food; and so is the bandicoot, the largest existing rat, which is eaten in India and Ceylon. Birds of the Gallinaceæ —domestic fowl, turkey, pheasant, partridge, pea-fowl—are very abundant. This is the habitat of the jungle-fowl, from one of whose numerous species the ordinary domestic poultry have descended. Pheasants are also naturally largely represented; and peacock or pea-fowl is found throughout the region, from Ceylon to the Himalayas and east to China, besides the argus, impeyan, tragapan, and others of the pheasant species. The brush-turkeys or mound-builders, related to the American curassows, are seen in Borneo, the Philippine and other islands.

(*c*) Africa, including Madagascar and neighbouring small islands of the tropics. The Cape buffalo is the only natural representative of the ox family; the aoudad is, however, allied to the oxen, and moufflon to the sheep—both are found in North Africa. Deer, sheep, and goats, in their natural condition, are entirely absent; the only deer-like animals are the chevrotain of Sahara and the ibex in Abyssinia. Antelopes are very abundant, and include many species, which we may class as follows: (1) Desert antelopes, as the gazelle; (2) bush antelopes, as the koodoo, bush-bok, and water-buck; (3) rock antelopes, as the klip-springer; (4) antelopes of the plains, as harte-beste, spring-bok, gnu, gems-bok, and bles-bok. Native horses are represented by the quagga and zebra. Swine are only represented by the wart-hog and horned-hog, or babyrussa; but the hippopotamus is closely related to

the Suidæ, and is often eaten for pork; and there are five species of rhinoceros. The ordinary pig is bred, and does very well on the hills. The agama is a lizard eaten for food, and represents the iguana of South America. There is an abundance of birds upon the continent; but the Gallinaceæ, which are most suitable for food, are badly represented. Grouse is represented by the Francolin, and pheasant by the guinea-fowl—there are no others. The nkuku is an African fowl, of small size, but most delicate. The ordinary domestic fowls, pigeons, ducks, and guinea-fowls, are propagated. River and lake fish are plentiful at certain seasons, about fifty species of the carp family being present, and others peculiar to the region.

(*d*) The animals of North America include deer, reindeer, moose or elk, and the musk-ox in the north; the bison or buffalo, one of the mountains, another of the plains; the cabrit or prong-buck of the western plains, and the argali or Rocky Mountain sheep, both threatened with extinction. Goats and sheep in their normal condition are absent, except for the bighorn or Rocky Mountain sheep. The Canadian stag or wapiti extends as far as Mexico, and the cariboo of the north is allied to the rein-deer. In this favoured region, however, an abundance of oxen, sheep, and other animals necessary to supply man with meat, readily thrive. Hares are found, but as we proceed to the south they are replaced by cavies. Birds and fish are abundant in the forests, woods, rivers, and lakes, as well as on the extensive coast.

(*e*) In South America, Central America, and the West Indies the cattle and sheep are prolific, and are bred in sufficient abundance to supply the wants of man. Swine are only represented by the peccary; sheep, goats, and oxen are entirely absent from the native inhabitants of the country; deer are found in limited numbers from Mexico to Patagonia; camels are represented by the llama, alpaca, vicuna, and guanaco, all of which have been eaten for food; hares and rabbits are absent, but their place is abundantly taken by the cavies, agoutis, paca, coypou, and capybara, which vary in size from a hare to a large dog; the raccoon, an animal of the size of a fox and belonging to the bear family, is eaten; the iguana, a lizard, is considered a delicacy; and even the armadillo, an edentate animal, forms a dainty dish. Game birds are not very numerous, the curassows

and guans, which are the largest, taking the place of the Old World grouse and pheasant. Fresh-water fishes are very numerous.

(*f*) Australia and Polynesia, including the Continent of Australia, New Zealand, Tasmania, and the Polynesian Archipelago. The greater portion of the Australian mainland consists of a tableland of moderate elevation, characterized by a harsh and dry climate and absence of water; hence vegetable growth, suitable for animals in their native condition, is scanty during a great portion of the year, and consequently unfit for the development of vigorous animal life apart from the care and oversight of man. Cattle and sheep are bred there in large abundance, being superintended by man's watchful care, and rabbits now swarm in nearly every region; but nearly all the Old World animals are conspicuous by their absence, excepting where the ingenuity of man has been successful in transporting and rearing them. There is a solitary species or two of hog, and the chæropus, a pig-footed animal which is similar in appearance to the moose-deer of the Oriental region. Kangaroo and kangaroo-rats are the most important mammals, and both are eaten, the former for venison, the latter for hare. Amongst birds there are few native representatives of the Gallinaceæ. The jungle-fowl of Australia, or mound-builder, is the *Megapodius tumulus*, and is similar to a turkey. Bustards or wild turkeys are similar. Pheasant is represented by the lyre-bird, and there are wild ducks, geese, and quails. More than forty species of pigeons are seen, and they are abundant, Australia and New Guinea being considered their native habitat. Fish is abundant in the sea and rivers, as bream, mullet, mackerel, grayling, and whiting. Less than forty species of fresh-water fish are known; but some of them belong to the Salmonidæ—salmon and trout. The codfish family is absent from Australian waters, but about six species are found in those of New Zealand. The flat fishes are abundant in the waters of the tropical islands. In the Polynesian realm the mammalia are the same, and the birds which are absent from Australia are also absent here; but there are plenty of pigeons, crows, cuckoos, kingfishers, and herons.

Vegetables, such as are eaten as 'greens,' are not abundant in tropical regions; but being fully aware of the necessity for green

vegetables, especially by the non-native residents of hot countries, it is important that the best use be made of those which are at their disposal. **Crambe** is a kind of cabbage (Cruciferæ) growing in Asia and Southern Europe. One of its species is the original of seakale. The **cabbage-palm** and the head of the **tree-fern** are used as cabbage in Australia. The unopened leaf-bud is boiled and eaten in the West Indies, but its removal destroys the tree. **Burdock** is a weed in many parts of the world, but its young leaves and shoots (called gobo) are boiled and eaten as a green vegetable in Japan, and the whole plant is boiled in soup. The stalks and petioles of **tacca** are boiled as a vegetable in China, Indo-China, and adjoining countries. The leaves of *Tetragonia expansa* are called spinach in New Zealand, and used as such. In Africa the plant called **mtake** is used as spinach. **Taro** leaves are eaten in the same manner in the Pacific Islands, and the **water-shields** in India, Australia, and America. **Onions** may be grown in all parts of the world, from the tropics to the coldest verge of the temperate zone, and form a suitable vegetable, having undoubted antiscorbutic powers. Varieties of **lettuce** are native in nearly all parts of the globe. **Tomatoes** grow in all warm districts. **Rhubarb** is valuable; stalks and leaves are both used. It grows in Europe, Russia, Turkey, Northern India, and Central Asia generally. Vegetable marrow, pumpkin, squash, and other members of the **gourd** family, are grown in all warm countries and elsewhere under the care of man. The fruit of **papaw** is boiled and eaten with meat, as other vegetables, in Africa and India. **Plantains** and green bananas boiled or roasted in ashes, and green **Indian corn** boiled in milk or roasted in ashes, are eaten as a vegetable. **Cardoons** have a succulent stalk and leaf, which is blanched and eaten like celery in all Mediterranean countries. **Skirret**, or water-parsnip, is a tuberous root, eaten with pepper and salt, after being half boiled and half roasted, in Southern Europe and all Oriental countries. The tuberous roots of taro are boiled in several waters and eaten like potatoes in the Pacific Islands. **Tacca** has also a tuberous root, which is cooked and eaten in the same manner in India, China, Cochin-China, and the Malay Archipelago. The tubers of the **lotus** are used as a culinary vegetable in China. **Yams, sweet potatoes**, and **manioc** or cassava root, are all eaten like potatoes wherever they grow.

Cassava root, however, must be boiled in several waters to remove the juice, which is unpleasant and injurious. The *Arracacha esculenta* of South America has a tuberous root, which is boiled and eaten like potatoes. It is very prolific and a staple food.

Amongst materials used as substitutes for bread, besides the tuberous roots mentioned, are durra, millet, buckwheat, and, of course, the cereals and pulses. Canna and cassava root are used as potatoes, but cassava, tapioca, and arrowroot are prepared from them. A nutritious farinaceous material is obtained from taro roots, called poi, in the Pacific Islands. The ground-nuts—*e.g.*, *apios tuberosa*, leguminous plants bearing tubers on their underground shoots—are eaten like potatoes, and their meal is used for cakes, etc., in the West Indies, China, South America, and France. **Chestnuts** are roasted and eaten in Spain, Italy, and other parts of Europe and Asia. The **araucaria**, a coniferous tree of South America and the Pacific Islands, bears large cones, each scale of which contains a large seed, which are roasted and eaten in Chili. The **bread-nut** of the West Indies is roasted and eaten as bread; and the oblong **bread-fruit**, the Jack-tree of tropical Asia, contains seeds like chestnuts, which are roasted and eaten.

Fruit.—If green vegetables of the orders usually consumed as 'greens' in Europe are scarce in hot climates, the deficiency is largely made up by the abundance of fruit, which may be eaten freely, providing a due proportion of meat and carbohydrate material are also taken in other ways. Oranges grow in all warm countries of Southern Europe, Asia, Africa, America, and the islands of warm latitudes. There are many varieties, equally good, but some are more juicy and sweeter. There are certain other fruits allied to them, as the **shaddock** (*Citrus decumana*), a large species of orange, with pale yellow skin and reddish pulp, in China, Japan, and the West Indies. The **wampee**, a fruit of the size of a pigeon's egg, which grows in bunches on a tree in China and the islands of the Indian Archipelago, also belongs to the orange family. Lemons, citrons, limes, and other fruit of the Aurantiaceæ, grow in the same districts as oranges. The **akee** fruit (*Blighia sapida*), of the West Indies and South America, is an oblong orange-coloured fruit, containing seeds in a juicy pulp, which is very grateful to the palate and highly esteemed. The **star-apple**

of the West Indies and tropical America is *Chrysophyllum cainito* and other species of the Chrysophyllum; it is as big as an apple, divided into sections or compartments, each of which contains a black seed surrounded by a gelatinous pulp. Olives grow in Southern Europe, Turkey, the Greek islands, Asia Minor, China, Japan, etc. The tomato, though a native of South America, will grow everywhere if the sun is warm enough to ripen the fruit. The gourd family is important in providing the human race with vegetables and fruit of no high nutritive value, which, however, contain a good deal of sugar and salts, and an abundant, agreeable juice. **Melon**, or *Cucumis melo*, is grown in Southern Europe, the countries of the Mediterranean, Egypt, Persia, and nearly all warm climates. The **water-melon**, or *Citrullis cucumis*, grows in most hot and dry regions, especially such as have a warm sandy soil, as Egypt, India, China, Japan, Malay Archipelago, West Indies, and America. It is one of the chief sources of meat and drink during some months of each year for a large portion of the population of North Africa. The **calabash, baobab**, or **sour-gourd** of North Africa, and another sour-gourd in Australia, are large fruit, the pulp of which is acid but pleasant. The juice mixed with sugar makes an agreeable beverage. The **anona** are species of plants growing in the East and West Indies and South America which yield agreeable fruit: as the sweet and luscious **sweet-sop**; the slightly acid **sour-sop**; the **custard-apple** or cherymoya, with its thick and luscious pulp; and the **mimusops**, also called bully or bullet fruit, which grow in the tropical regions of both hemispheres, but especially in Ceylon and British Guiana; the fruit is delicious and of the size of a cherry. Many cacti have fleshy, succulent stems, which yield a slightly acid, watery, or a sweetish milky juice, which is refreshing, and is used as a beverage. Their fruit is also eaten. The **prickly pear** or opuntia is the fruit of a cactus having a pleasant subacid taste; it is eaten wherever it grows, as in Southern Europe, Asia, the West Indies, and South America. The **strawberry pear** of the West Indies is the fruit of another cactus, and is eaten. Besides the palm upon which dates are grown, there are others which bear eatable fruit, as the **dorn-palm** of Northern and Central Africa, where it forms forests. This tree bears a fruit of about the size of an apple, having a fibrous, mealy rind which

tastes like ginger-bread. The **alligator pear** of the West Indies (*Persea gratissima*) is a big fruit, from 1 to 2 pounds in weight, having a firm and marrow-like pulp, which is highly esteemed. It is also called the **avocado.** The **cream-fruit** of Sierra Leone is the produce of an apocynaceous plant, and has an abundant creamy juice, for which it is eaten. The **hog-plum** (*Spondias dulcis*, N.O. Anacardiaceæ) is a fruit growing in the Society Islands, which is compared to the pine-apple. **Mangosteen** is a delicious and wholesome fruit of the size of an orange (*Garcinia mangostana*, N.O. Guttiferæ), in the East Indies and Malay Archipelago. **Carambola** (*Averrhoa carambola*) is an East Indian fruit of the size of an egg, and of agreeable acid flavour; it is used for jam, tarts, sherbet, and wine. **Mango**, the fruit of the mango-tree (*Mangifera indicana*, N.O. Anacardiaceæ), grows freely in Asia and other tropical countries. The fruit is luscious, somewhat acid, but highly esteemed for dessert. It contains a large kernel, which is very nutritious, and has been used for food in times of scarcity. **Chutney** is an East Indian condiment made from ripe mangoes, raisins, lemon juice, sour herbs, and cayenne, boiled and pounded together. **Mangroves** (*Rhizophora mangle*) are a sweet, edible fruit of the East and West Indies and other tropical countries. Wine is made from the juice. In the West Indies and Brazil the **calaba-tree** yields an agreeable green fruit, and the **Barbadoes cherry** is a tart, fleshy fruit, but pleasant to eat. **Boldoa** fruit, eaten in Chili, is pulpy and juicy. The **abelmosk** is the mucilaginous fruit of an evergreen shrub growing in tropical America, the West Indies, and Asia. It is used in pickles and soup. The **durian** or durio is a peculiar fruit of fœtid odour, but having such a delicious flavour as to place it in the fore-rank of tropical fruit. It is the size of a human head, and a native of the islands of the Indian Pacific Ocean and Malay Archipelago.

Nuts of various kinds, as the coco-nut and Brazil-nut, occur in most parts of the earth. Various tubers, such as the ground-nut and various species of Coleus and Plectranthus, which much resemble potatoes, are cultivated in the tropics. Besides manioc and cassava, there are species of yam and sweet potato grown in many places. Various starches obtained from roots and fruit are freely used. Ling in China and singhara in India and other

Eastern countries, which consist of the powdered kernels of **water-chestnut** (*Trapa bispinosa* and varieties, N.O. Onagraceæ), are examples. The meal is better than millet as a food, being richer in flesh-forming and energy-producing material. Dr. Hooper gives the following composition of water-chestnut: Water, 4·1 per cent.; proteid, 14·3; fat, 0·97; carbohydrate, 78·1; fibre, 3·6; ash, 4·6. Balland gives the following:

	Water.	Proteid.	Fat.	Carbohydrate.	Cellulose.	Ash.
Coleus dazo	77·3	1·72	0·54	18·2	1·3	—
Plectranthus ternatus ...	71·3	2·74	0·39	22·6	1·26	1·27

In some places the unripe **bread-fruit** (*Artocarpus incisa*) is ground into flour; and in Tahiti the **mapé** is a coarse starch obtained from *Inocarpus edulis*. In French Guinea and other parts of Africa a flour called **neté** is obtained from the pulp of the fruit *Parkia biglobosa*. **Caryot** and **talipot** are an inferior kind of starch from *Caryota urens* and *Corypha umbraculipera* respectively. In Polynesia and Oceania, various tubers are used for their starch—*e.g.*, **apé** is the flour obtained in Tahiti from the rhizomes of *Arum macrorhizum*, which is cultivated like the yam: **poi** is a meal obtained from taro or yam (*Caladium esculentum*), the tubers of which are much appreciated in Polynesia and other tropical countries; in Madagascar **tavola** is obtained from a kind of yam (*Tacca pinnatifida*); and in Japan **conophallus**, the tubers of *Amorphophallus*, closely related to yam, are ground into flour.[6]

Drink can be made from lemons, oranges, bananas, plantains, limes, citrons, pine-apples, and very many kinds of fruit. In Mexico **pulque** is made from the juice of the agave or American aloe, which is collected just when the flowering stem is ready to burst forth. It resembles cider, but has an odour of putrid meat. The juice of various cacti is used wherever they grow, and the fruit of the mangroves makes a light wine in the East and West Indies. The fruit of carambola is used to make sherbet in the East Indies, and the juice of the ordinary sour-gourd or calabash of North Africa makes a pleasant beverage. Various palms yield a plentiful sap or juice from the stem and fruit, which, being fermented, makes a sweet vinous beverage—*e.g.*, *Mauritia vinifera*, or South American palm. The sap of the palmyra is drunk in its natural condition in India and Ceylon, or fermented to make palm-wine. The milk of the coconut and the sap or

juice of the tree, grown in all tropical countries, makes a vinous beverage and a spirit called **toddy**. The **cow-tree** of South America yields an abundant juice which has the appearance of milk, is very nutritious, and is used for food. Another **milk-tree** in the West Indies is the *Taberna montana utilis*. Various beverages made from the milk of animals have been referred to, especially **koumiss** (*q.v.*), prepared by fermentation of milk, and used largely by Asiatic races. Another is **leban**, an Arabian beverage, consisting of coagulated sour milk diluted with water; **keffir** is another beverage prepared from the milk of cow, ass, or goat, and prepared in a similar manner to koumiss. Besides the above, various fermented liquors are made from rice, millet, and other grains: tar-asum in China; saké in Japan; chong in Thibet; ava in the South Sea Islands from ti-root; chica or sora from maize or manioc in Peru; and arrach in Ceylon from the juice of a palm-tree, or in India from the flowers of mnowha-tree, various palms, and grain.[7]

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PART III

FOOD AND HYGIENE IN SICKNESS

CHAPTER XX

ACUTE ILLNESS

The selection of food appropriate for a person suffering from an acute illness is a matter of great importance. Persons accustomed to an abundance of solid food cannot always be convinced, when their appetite remains good, that a change of condition necessitates a change of diet. A man confined to a sick bed, with his body and mind at rest, his vital processes all slack, his heart, lungs, and stomach all working with less energy, requires a smaller amount of fuel than usual to keep his machinery going. But, although reduced in amount, it should be remembered that the internal work of the body is going on, and the fabric is being worn out by that work; that so long as the human machinery is going, heat and energy will be required; and to produce the requisite heat and energy, and to make good the losses by wear and tear or 'depreciation of the machinery,' material must be supplied and assimilated. During fasting with absolute rest the body wastes, and its temperature is maintained at or near 98·4° F.

In a healthy individual the daily losses of the body are 300 grains of nitrogen, 4,200 grains of carbon, 360 grains of salts, and 30,000 grains of water; but during sickness these amounts are frequently increased by pathological processes, and it often taxes the ingenuity and judgment of the attendants to make these losses good. In other words, the normal daily excretion of nitrogen is 11 or 12 grammes, but this is often increased considerably during an illness of a feverish nature. Thus, the excretion of nitrogen in five cases of pneumonia was found by

Ewald to average 19·13 grammes per diem, which required a supply of 1·5 to 2 grammes of albumin per kilogramme of body-weight, or a total amount of 112 to 136 grammes of proteid daily. The amount of heat and energy expended by the human machinery in a day during health averages 2,310 calories or units of heat; but it is often increased in sickness to 2,500 or 3,000 calories, or 35 to 40 calories per kilogramme of body-weight per diem.

In illness the nutrition is to be maintained on the principle of giving sustenance without increasing nitrogenous waste, care being taken that the food is sufficient to make good the losses of the body, and at the same time wholesome and easily digestible. The composition of foods being known, it is not difficult to calculate the amount required to produce 2,500 calories and 100 or more grammes of proteid; for 1 gramme of proteid will yield 4·5 calories, of carbohydrate 4·1, of alcohol 7, and of fat 9·1; and 100 grammes of proteid contain 14 grammes (396 grains) of nitrogen. The following dietary is sufficient to supply these amounts:

					Proteid.	Carbo-hydrate.	Fat.	
4 pints, or	2,268	grammes of	milk	=	90	108	83	grammes.
2 ounces, or	56·70	,,	oatmeal	=	7·2	35·5	3·1	,,
2 ,,	56·70	,,	arrowroot	=	0·5	47·5	—	,,
4 ,,	113·40	,,	bread	=	9·0	56·7	1·7	,,
¾ ,,	21·26	,,	sugar	=	—	21·0	—	,,
½ ,,	14·17	,,	butter	=	0·5	—	12·4	,,
	Total	...	...	...	107·2	268·7	100·2	

The yield of heat and energy from this diet is about 2,500 calories, thus:

Proteid	$107{\cdot}2 \times 4{\cdot}5$	=	482·40
Carbohydrate	$268{\cdot}7 \times 4{\cdot}1$	=	1101·67
Fat	$100{\cdot}2 \times 9{\cdot}1$	=	911·82
			2495·89

More milk may be added to increase the proteid, and the amount of farinaceous materials may be diminished; 1 pint of milk contains about 23 grammes of proteid, and will yield 410 calories.

Milk and its preparations forms the staple diet in sickness, because it contains the principles of a typical food in such a form as to be easily digested and assimilated. All milk should be cooked, but it may afterwards be drunk cold if it is preferred so. Milk is always curdled during its digestion; but the curds

produced in boiled milk are smaller than those in raw milk, for which reason boiled milk is more easily digested, and it has the advantage of being sterilized. When vomiting occurs during an illness, the addition of an equal amount of lime-water, barley-water, or soda-water to the milk will check it, and prevent the formation of hard or tough curds in the milk during digestion. Milk disagrees with fat, heavy, or languid people of slow circulation, with many people of sedentary habits, and those whose stomach is weakened by alcoholic excesses. But with a little patience the system will accommodate itself to the new food, which becomes a bland and soothing diet. To a very few people, milk is really insupportable ; they cannot digest it, it gives them a headache, and makes them vomit or upsets their liver. Plain milk should not be forced upon such people; but they can usually take it diluted with lime-water, barley-water, or soda-water ; they can also take milk-powder or casein preparations ; and during convalescence they may be able to take milk puddings, custard, junket, clotted cream, cream cheese, or new milk cheese, and from these things obtain the valuable principles of milk.

Eggs are a very important and excellent article of diet for sick people ; combined with milk they will adequately replace meat during the period when solid food is not allowable. Raw eggs may be given in boiled milk, tea, coffee, soup, or egg-flip ; two or three a day is a fair quantity for an adult, and one a day for a child of a year or two old. The white of an egg, well whipped, may be given in lemon-water to a person who vomits other food ; it is a pleasant drink, relished by patients, and assists in checking nausea. Custards, farinaceous puddings, and other modes of preparing eggs for the sick, are known to most cooks. Poached or scrambled eggs are very light, and make a suitable meal for those who are not feverish. Two eggs weighing 113 grammes contain 14·2 grammes of proteid, 10·7 of fat, and yield about 160 calories or units of heat.

Farinaceous foods, such as fine oatmeal, baked flour, banana flour, prepared barley, arrowroot, cornflour, revalenta, semolina, rice, sago, tapioca, vermicelli, macaroni, mashed potato, dry toast, bread, sponge cake, madeira and other light cakes, are most of them easily digested, and are the means of conveying into the system much nutriment capable of supplying heat and energy.

Concerning the digestibility of starch, it may be said that starch from roots—*e.g.*, arrowroot, *tous le mois*, and potato starch—are far more rapidly and easily digested than the cereals. Sago and tapioca are also very easily digested, which indicates that these substances should be given earlier in the illness than bread, baked flour, oatmeal, cornflour or rice. There are many exceedingly useful patent foods, some of which are malted or so changed as to be adapted for most conditions of ill-health. It should, however, never be forgotten that during a high temperature and some other conditions of the body the mouth is dry and the salivary and other digestive secretions are scanty or deficient in quality, from which it follows that a large quantity of any kind of farinaceous food, unless predigested, cannot be assimilated during the continuance of that condition, but will cause indigestion, flatulence, distension of the bowels, and other discomfort.

Beef-tea, soup, broth, and meat essences generally, are used during the acute stage of nearly all forms of illness. They contain only 6 per cent. of dissolved and coagulated albumin, 1 or 2 per cent. of carbohydrate, and some salts; in fact, they are very expensive but not very valuable articles of food. One pint of beef-tea, made from a pound of lean beef, will yield roughly 22 to 33 grammes of proteid, but only 115 to 200 calories; it should be observed that this is less than half the caloric value of the same quantity of milk (see 'Beef-tea'). These liquids are, however, stimulants to tissue change, and are not to be despised altogether, although they are not relied on now so much as formerly. They may be taken to the extent of 1 pint in twenty-four hours. Patients soon tire of them. The flavour of beef-tea or broth should be changed every time a fresh supply is made; onion, celery, parsley, mint, thyme, marjoram, savory, or bay-leaf may all be used in turn, care being taken that the vegetable is removed before giving the liquid to the patient. Mushroom ketchup or tomato sauce may be used as a flavouring; but heavy vegetables like turnips should never be used to make broth for invalids, because they contain an indigestible oil.

Drink.—The thirst of a patient may be quenched by giving frequent sips of cold water, small particles of ice,* or a slice of

* It is sometimes a difficult matter to keep ice in a sick-room. The following method has been found useful: Put the chipped ice in a soup-plate and cover it

lemon to suck. The following liquids may also be given *ad libitum*, providing they are not consumed to the exclusion of milk or other nourishment: lemon-water, orange-water, apple-water, raspberry vinegar and water, black-currant tea, linseed tea, barley-water, oatmeal-water, rice-water, butter-milk, whey, tamarind-whey, koumiss, etc. Fruit-jellies, such as black-currant, raspberry, apple, and barberry jelly, which contain organic acids, are also useful to quench thirst. It should be observed, however, that very much calf's-foot jelly or ordinary jelly made with gelatine will not quench the thirst, but has a tendency to aggravate it.

Stimulants.—In acute illness, tea, coffee, and cocoa are all valuable stimulants and restoratives, which can be made the means of inducing the patient to drink milk. Tea and coffee can be made double the ordinary strength and diluted with an equal quantity of boiled milk; cocoa should be, and coffee may be, made entirely of milk. Guarana and maté are very useful stimulants for cases in which headache or nervous exhaustion is a marked feature of the illness.

Alcohol must be used sparingly; it is a valuable diffusible stimulant, and is best given in the form of a spirit. A tablespoonful of brandy or whisky every two or three hours is considered a moderate dose for an adult; children require less in proportion to their age; it should be given in milk or some other article of food. Four ounces of brandy containing 36 per cent. of alcohol will yield 43 c.c. of absolute alcohol and 300 calories; 4 ounces of whisky containing 50 per cent. of alcohol will yield 410 calories, which represent the value of the spirit as a food. The indications for the use of alcohol are a pulse of 120 or more per minute, a dry brown tongue, and signs of exhaustion; in such cases it strengthens the heart, encourages the circulation, enlivens the patient, and assists in lowering the temperature. But due caution is required, as these effects may be followed by depression, which spreads rapidly from the higher nerve-centres to the lower. If the dryness of the tongue increases or it becomes browner, the thirst is greater, the pulse and respirations quicker after alcohol

with another. Place the plate upon a feather pillow, press it down, and put another pillow on the top. Ice can be kept a long time in this way, because the feathers are non-conductors of heat.

than before it, it is doing more harm than good; its place should be occupied by other stimulants, such as musk or ammonia. The patient's habits must be taken into consideration when deciding whether to give alcohol or not, as well as his age, the nature of the disease, and state of his kidneys. In some cases of extreme prostration alcohol is a valuable ally; it becomes absolutely a food which yields heat and energy while undergoing oxidation, the amount of heat being 7 calories for each gramme of absolute alcohol. It never becomes an integral part of the body, but it spares the destruction of the protoplasm of the body, and to a corresponding degree diminishes the formation and elimination of waste materials; correlative facts prove a reduction in the absorption of oxygen and of the temperature of the body owing to diminished oxidation. These facts led to the use of large quantities of whisky and brandy, 1 pint or more per day, in the treatment of such cases; but the necessity for such quantities is by no means obvious, and the experience of temperance hospitals proves that the same class of cases can be treated as well without it, and sometimes with better results. Owing, therefore, to the tendency to form a habit, to the natural excuse that the doctor ordered it, and to the dire effects such habit may have upon the moral and physical condition of the consumer, it behoves us to be exceedingly cautious about the use of so powerful, so valuable, and at the same time so pernicious an article. The dose of two teaspoonfuls to a tablespoonful, measured in a graduated measuring glass, every three hours is equivalent to 2 to 4 ounces in twenty-four hours. When administering it to infants, great care is required to insure the accurate measurement of the dose and its proper distribution over the twenty-four hours. Let a teaspoonful of brandy be mixed with $1\frac{1}{2}$ ounces of sweetened water in a bottle; each teaspoonful will contain 5 drops, which is a sufficient dose for an infant under a year old, and may be given every two or three hours according to necessity. There are various alcoholic mixtures suitable for patients during an acute illness, *e.g.*:

(*a*) *Egg-flip.*—Beat well the entire raw egg, pour upon it a teacupful of boiling milk, add a tablespoonful of brandy or whisky and a little sugar.

(*b*) *Egg-wine.*—Add a tablespoonful of cold water to a raw egg, whip it thoroughly, pour upon it half a teacupful of hot

water and a wineglassful of port or sherry, stirring it all the time; put the mixture into a clean saucepan over a fire, and stir it in one direction until it thickens; it should not be allowed to boil. Serve it in a glass, with a strip of toast or a biscuit. Sometimes wine is mixed with raw eggs without heating them.

(*c*) The *Brandy Mixture* of the British Pharmacopœia consists of 4 ounces of brandy and of cinnamon water, the yolk of two eggs, and $\frac{1}{2}$ ounce of castor sugar thoroughly mixed together. The dose is half a wineglassful every three hours. Alcohol may also be added to various foods, such as jelly or soup; in fact, there are innumerable ways of combining the flavour and stimulating qualities of wine or spirits with the food.

The proper feeding of a sick person is a distinguishing quality of a good nurse, for the welfare and comfort of the patient depends very much upon the amount and quality of the food and its mode of administration. A helpless person can be most easily fed by means of a feeding-cup, which should only be three parts filled, to avoid spilling the contents over the clothing. The patient can be slightly raised for the purpose by placing a hand under the shoulders or the pillow. The patient cannot be raised by putting a hand under the head; this would only bend the neck, and a female would be teased by catching the fingers in her hair. A patient who is acutely ill should not, as a general rule, be allowed to go more than two hours without food, because faintness and exhaustion are so easily induced. Instruction should be given to the nurse if it is considered desirable to awaken a patient for food. When only liquid food is being taken, the patient may be roused just enough to drink some milk or beef-tea, and then fall asleep again. Sometimes it requires a little judgment to know what to do. If the patient has had sleepless nights or days for some time previously, the sleep may be more important than the food; if, on the other hand, the person sleeps well, and a long interval has elapsed from the last meal, he should be aroused for his food rather than faintness should be induced; when a patient both sleeps well and takes regular meals there need be no scruple about wakening him.

Patients are sometimes starved in the midst of plenty from want of attention to the ways which make it possible for them to

take sufficient food. A person may be unable to drink a cupful of milk or beef-tea at once, but would probably be able to take a tablespoonful or two of milk, egg and milk, beef-tea, or farinaceous food, every fifteen or thirty minutes ; this would be far better than the hopeless attempt to force a much larger quantity upon him every two or three hours. A tablespoonful of milk every half an hour would amount to $1\frac{1}{4}$ pints in twenty-four hours—that is, not enough to supply the needs of the system. Four tablespoonfuls or a wineglassful every half an hour would amount to nearly 5 pints in twenty-four hours, which is enough to supply the demands of the system for water and proteid ; it would produce 2,000 calories or units of heat, and the proper caloric requirement could be obtained by thickening some of the milk with arrowroot and sweetening it with sugar. It surprises many people to find how much food can be consumed by adopting the principle of 'little and often' in the method of feeding.

When the acute stage is passing off the amount of food to be taken must depend very much on the likes and dislikes of the patients, the normal requirements of the body always being the guide as to sufficiency ; observation is the best guide and appetite the rule. Milk should still be an important item of the dietary. Half a pint of milk with an egg in it will give more nourishment than $\frac{1}{4}$ pound of meat, and is far more easily digested : 10 ounces of milk and an egg contains 18·6 grammes of proteid, 13·5 of carbohydrate, 15·7 of fat, and would yield 282 calories ; 4 ounces of cooked meat contains 31·8 grammes of proteid, 17·5 of fat, and would yield 213 calories. Milk is less troublesome to the digestive organs than meat, and being free from purin bases, is less irritating to the kidneys. The addition of eggs to farinaceous foods, milk puddings, and the like, materially adds to their nutritiousness and wholesomeness. Butter is the lightest and most easily digested fat ; cream contains the same kind of fat, is readily digested by most people, and is indispensable in some cases of illness. Sugar is a very ready means of supplying carbohydrate, and is easily absorbed by most patients ; it can be freely used in many articles of food. Arrowroot, cornflour, sago, tapioca, and rice, consisting more of starch than anything else, are not so nourishing as oatmeal, banana flour, maize meal, baked flour, semolina, vermicelli, and macaroni. Soup, broth, jelly, dry

toast, a little bread-and-butter, sponge cake, and Madeira cake, may now form a part of the dietary.

During convalescence, which dates from the passing of the acute stage or period of abnormal temperature, the patient may be allowed to have milk puddings; and as the digestive organs recover their wonted functions, fish, oysters, and white flesh can be gradually added to the list. Larger meals, consisting of a greater variety of food, should be taken at longer intervals. Food should be now taken every two hours, or at longer intervals in proportion to the solidity and quantity of food consumed. The following list gives an ample selection of articles suitable for the convalescent: **Fish** which has been steamed, of the light and soft kinds—*e.g.*, whiting, sole, plaice, brill, turbot, haddock, flounder, and cod. The following kinds of fish are *not suitable:* mackerel, salmon, trout, halibut, ling, skate, eel, conger-eel, lamprey, gudgeon, sturgeon, mullet, etc. Oysters are allowed to be eaten raw; cooking them makes them indigestible. **Chicken**, pheasant, partridge, pigeon, rabbit, mutton, and calves' head or feet, are all suitable when simply cooked and without forcemeat or condiments. The following are *unsuitable:* duck, goose, hare, and game generally; veal, pork, sausage, ham, and highly-seasoned dishes.

Vegetables are not admissible during the acute stage, but in convalescence we *may allow* a moderate amount of potato, cauliflower, spinach, vegetable marrow, squash, tomato, kidney beans, green peas, and other soft vegetables, or a *purée* made from them. But cabbage, turnips, carrots, and other heavy vegetables, and raw vegetables like lettuce, celery, radishes, onions, and **pickles**, are unsuitable; they are bulky, generate gases, and are a tax upon the digestive organs.

Fruit is tabooed in the acute stage of many diseases, but the juice of grapes, oranges, and lemons may be given. When the abdominal organs are not implicated we may allow a few grapes, strawberries, raspberries, mulberries, a banana or an orange. During convalescence these fruits may be allowed freely, as well as cooked apples, pears, rhubarb, or plums, taking care that they are not consumed to the exclusion of more important articles of food.

The meal should be fully prepared before it is presented to the

patient; he should not be kept waiting for knife, spoon, bread, or any other article. The appetite only comes at intervals, and if the patient is kept waiting a few minutes the desire for food may vanish, and leave behind a sense of faintness and languor. The food should be presented in a clean and tidy fashion, for the appetite is coy and requires courting. Badly prepared, untidily presented, or unsightly food will often drive away the appetite. Let the food, therefore, be on a nice piece of china—for preference some article the patient is fond of—placed upon a clean napkin or d'oyley, with other articles to correspond; a poor appetite may be tempted and lured by food daintily prepared and presented. If the patient expresses a desire for any particular article of food, it should not be given without the doctor's permission, nor should his concurrence be unreasonably withheld. Food should never be kept in a sick-room, excepting a very small quantity of milk or similar article for immediate use. Do not take the patient too large a meal, but get more for him if he can eat it. All plates, china, glasses, and other articles, should be removed from the room as soon as the meal is over. Food which has been in the sick-room should not be eaten elsewhere.

THE FEVERS.

Heat is produced by every act of vital energy, is distributed throughout the body, and finally lost in the surrounding air. It is developed during metabolism by the chemical and physiological processes which are constantly going on in the body. Its production and loss is governed by the nervous system, and it is used for warming the body, for conversion into energy, and to cause an evaporation of water from the surface of the skin. Most heat is produced in the muscles. It disappears from the body through the skin by radiation, conduction, or convection, and evaporation of water. The escape or loss of heat is regulated by 'centres' in the nervous system acting through the vaso-motor and vaso-constrictor nerves which govern the circulation of blood through the skin. If the skin becomes hot the bloodvessels dilate and more blood circulates through it, the sweat glands are stimulated, and heat and moisture escape to the surrounding air. A rise of the body temperature is due either to increased produc-

tion or diminished loss of heat. The mechanism which regulates the temperature is very liable to become disordered, and such disturbance will lead to an increased production or a diminished loss of heat. Independently of this, an increased production of heat takes place in many fevers, and a diminution in the loss of heat in other circumstances, a familiar example being a 'chill' from damp or cold. Such disturbances of the temperature of the body occur in all fevers where the body is invaded by pathogenic organisms, which settle in and thrive upon the pabulum of the tissues, and throw their toxins into the plasma and blood. By their metabolism these organisms give rise to increased heat production, and, on the other hand, their toxins disorder the heat mechanism and cause a diminution in the loss of heat. Even in a local inflammation, such as an abscess or a symptomatic fever, there is a local increase of metabolism with increased production of heat, and, as in specific fevers, the heat-regulating apparatus is disturbed by the toxins arising in the inflamed area. In other local maladies, like renal or hepatic colic, which are not particularly associated with bacteria or other microbes, the functions of the heat centre are upset by peripheral irritation; the high temperature is then attributed to reflex stimulation of the heat centre, just as profuse perspiration may be produced by a reflex stimulation of the sweat centre.

What is a high temperature? The normal temperature of 98·4° F. is maintained in a healthy individual in all climates and under all circumstances, so well is the production and loss of heat regulated by the nervous system. Nevertheless, the body temperature fluctuates in every healthy individual, *the daily range being* 1°. It is lowest between 2 and 7 a.m.; it gradually rises from 7 a.m. to 2 p.m., and remains at its maximum until 7 or 8 p.m., after which it slowly falls till midnight. These daily variations are much exaggerated during sickness. A moderate degree of fever is that which is attended by a temperature of 99° to 101° in the morning, rising to 102·5° in the evening. In a severe fever the temperature is 101° to 103° in the morning, and rises to 105° in the evening. A condition of *hyperpyrexia* exists when the temperature rises to more than 105°, and the patient seldom recovers if it exceeds 107°. A *subnormal* temperature is quite common after a course of inflammation or fever, and

generally ranges from 97° to 96°; in a state of shock or collapse it may sink to 95° or even 92°. When it sinks to 92° and remains so persistently, the patient seldom recovers.

In all the infectious diseases micro-organisms gain access to the body, and require a period for their development, which is known as the 'incubation stage.' During this period the bacteria multiply rapidly by fission and spore formation, and various products of their metabolic activity are formed. Research points to the symptoms of infectious diseases being due not so much to the action of the microbes on the tissues as to their products. The latter include chemical substances, ptomaines, toxalbumins, and albumoses, which are more or less soluble, and briefly called 'toxins,' besides less powerful bodies, such as gases, pigments, fatty acids, and aromatic substances. Observations have been made in most of the infectious diseases which show that the 'toxins' exert a direct action upon the cells of the body and upon the heat-regulating apparatus. Whether the disease will develop or run a mild or severe course depends upon the power of the body to resist it. During health immunity from disease is enjoyed, owing to the protective influence exerted by the cells, and their ability to resist the invasion of the parasites. Some authors assert that this defensive action is due to the proteid ferments normally present in the bodily fluids which have a distinctly germicidal effect; the defensive power of blood-serum is believed to be due to a globulin which has such an effect on bacteria. On the other hand, it is known that the white cells of the blood and other body fluids grapple with such invaders and destroy them. Large irregular multinucleated cells, called phagocytes, are to be seen laden with bacteria, and it is probable that these cells secrete substances, called 'antitoxins,' which are capable of neutralizing the bacterial toxins. People in robust health are, by virtue of the cellular powers, *immune* to most diseases; some people possess an *innate immunity* to special diseases, as the negro to yellow fever; during an epidemic a certain number of persons always escape infection. *An acquired immunity* is conferred upon the system by having recently had a disease; and such immunity is imitated by vaccination against small-pox and inoculation for cholera and rabies. The explanation of immunity is far from complete; it does not depend solely

upon *phagocytosis*, or the destruction of bacteria by white cells of the infected person. The explanation probably lies in the stimulation of the body cells to greater resisting and antitoxic powers than they formerly possessed, and to the secretion of such antitoxins during the height or decline of the fever as destroy the life and effects of the bacteria. It is known that putrefactive bacteria produce by their action upon albuminous substances certain antiseptics, as indol, skatol, cresol, and other compounds of phenol, which destroy these organisms; and by analogy it is suggested that the decline of a fever is due to substances produced by the activity of the body cells or by the bacteria, thereby insuring their own death.

Fever is accompanied by disturbance of nearly every function in the body, which shows how profoundly the system is impressed by the bacterial invasion. Perhaps the first symptom of note is the rise of temperature, which is usually accompanied by a feeling of chilliness or a distinct rigor; although the surface of the body may be cold, the internal parts are hotter than normal, the skin soon becomes hot and dry or moist and warm, or an eruption appears upon it. The alimentary system is affected: the tongue gets furred, moist, and white, or dry and brown with red tip and edges; the mouth is dry from suspension of salivation; the coating on the tongue is an accumulation of epithelial scales, fungi, and dried secretion; thirst is due to the heat and dryness of the mouth and the absence of mucus and saliva; relish, appetite, and digestion are impaired, owing to a deficiency of the secretions, and the bowels are confined. The urine or secretion of the kidneys is likewise scanty, high-coloured, it deposits lithates and urea in excess, while chlorides are deficient. The heart is quickened, pulse 110 to 120 or more; the respirations also quicken as the temperature and pulse go up. The nervous system is profoundly affected, even during the stage of incubation; there is headache, disinclination to think or make mental effort, intellectual dulness, and, after a time, drowsiness, wandering, or actual delirium.

Treatment.—A. There are many ways in which we may assist in regulating the heat of the body. Thus, if we raise the temperature of the air around us, we shall increase the loss of heat from the body by perspiration: the cutaneous vessels dilate, and

more blood rushes through them, with a consequent increase of radiation and evaporation; the skin is the principal channel for heat loss. If we diminish metabolic activity by entire rest in bed, by lessening the circulation and respiration, and by abstaining from solid food, we lessen the heat production.

The temperature of the bedroom should be about 60° F., and the patient lightly covered with clothing. The difference of 40° or more between the temperature of the patient's body in fever and that of the surrounding air affords a valuable means of abstracting heat by radiation and convection. The room must be well ventilated, and the extremities kept warm by clothing or a hot-water bottle in the bed. Heat may be abstracted from the body by means of baths, wet packs, sponging the general surface, local application of ice, compresses, or evaporating lotions. (*a*) **Cold sponging** is a simple and easy method of abstracting heat, and may be used in almost every case. A basin of lukewarm or quite cold water is prepared, and a little Eau de Cologne or other spirit added; the patient is then placed upon a folded sheet, and uncovered and sponged limb by limb. The process should only occupy about ten minutes, during which the temperature falls 2° or more. The application is grateful, soothing, and agreeable to the patient, and often induces sleep. The temperature will probably rise again after a time, and the sponging may be repeated every four or six hours. (*b*) **The wet pack** may be used when the temperature exceeds 103°. The patient is stripped, laid upon a folded sheet over a mackintosh, then wrapped in another sheet wrung out of quite cold water and covered by a blanket or two. He is kept in it for ten or fifteen minutes, after which it may be removed and the patient gently rubbed down and made comfortable. The temperature falls several degrees, and may rise again. It may be repeated every four or six hours. (*c*) **The cold bath** is much used in enteric. The temperature of the patient is taken every three hours, and whenever it rises to 103° he is placed in a bath of water at 60°, 70°, or 80°, for ten or fifteen minutes, according to its effects, or until the temperature in the rectum is normal. He is then removed, lightly dried, and placed in bed. Sometimes the patient is put in a warm bath, and while he is in it cold water is added to lower the temperature of the bath to 70° or 65°. In most cases it suffices to have a

large bath near the bedside. The water soon attains the same temperature as the air of the room, and the patient can be lifted into it as often as it is desired; or the heat of the water can be raised by adding a kettleful of boiling water. (*d*) **Ice-bags** are local applications for abstracting heat from the head, chest, abdomen, a joint, or other inflamed part. (*e*) **Evaporating lotion** is applied by means of a fold of lint or linen, or by a skein of wool hanging from a bottle of lotion. (*f*) **Leiter's tube** consists of a coil of indiarubber tubing, through which water is constantly running, and it is applied to an inflamed area.

We can increase the loss of heat through the cutaneous circulation by dilating the bloodvessels and sending a larger amount of blood through them, and by stimulating the sweat glands. We do this when we use warm or hot baths (90° to 110° F.), vapour or Turkish baths, poultices, fomentations, turpentine stupes, and counter-irritants; warm food and liquids act in a similar manner. Alcohol and other cardiac stimulants, by driving more blood through the cutaneous bloodvessels, increase the refrigeration of the body; frequent draughts of warm or cold water cause a temporary distension of the bloodvessels, and produce a refrigerating effect. Increasing the clothing and the temperature of the air likewise dilates the vessels of the skin, stimulates the sweat centres, and causes a freer secretion by the sweat glands.

Other heat-losing channels may be stimulated. By increasing the flow of urine we have a direct means of abstracting heat and reducing temperature; this may be aided by such foods as oatmeal gruel, and drinks which act upon the kidneys, such as an abundance of plain water and its variants, lemon, black-currant, linseed, or barley water; by dilute alcohol; by foods containing an abundance of potash; by milk, tea or coffee. The administration of a purgative materially assists heat reduction by carrying away liquid, watery motions, and by the reflex dilatation of the cutaneous vessels which attends purgation. The action of the kidneys and bowels is disturbed in most feverish conditions, and by setting free these emunctories we may exert a decidedly beneficial effect upon the course of the fever.

Mere abstraction of heat from the body does not lessen heat production; this is made clear when the means used are bathing or the wet pack; the temperature is reduced 3° or 4° by abstrac-

tion, but it may soon go up to the same height again. We must, therefore, endeavour to get a diminished heat production—in other words, strike at the root of the disease. We diminish the metabolic activity and heat production by rest in bed, abstinence from solid food, and other hygienic measures, and it naturally decreases during the decline of the fever. Drugs, such as quinine, control the metabolism of the tissues, and are bactericidal; other drugs reduce the temperature and heat production by their influence on the centres governing the production of heat, or by slowing the action of the heart and lowering the circulation.

B. **The effects of pyrexia** must be met or removed. (*a*) There is a marked deficiency of saliva in all acute febrile or inflammatory states, and consequently thirst, dryness of the mouth and tongue, loss of taste, relish, and appetite, and inability to swallow solid food. **Thirst** may be quenched and dryness of the mouth removed by slightly acid drinks, which promote the secretion of saliva; such are the juice of oranges, lemons, grapes, drinks made from apples, prunes, cranberries, barberries, tamarind, and black-currant or raspberry vinegar. Demulcents relieve thirst and dryness by supplying an artificial substitute for the natural mucus; good examples are linseed tea, egg and water, jelly water, isinglass and milk, figs, raisins, syrup, honey, oxymel, glycerine, and starchy fluids made of cornflour or arrowroot. Frequent sips of pure water, ice-water, bits of ice, toast-water, soda-water, or other effervescing draughts, will relieve thirst and dryness. Water and its mixtures may usually be taken freely; besides quenching the thirst, they thin the blood, increase the circulation through the skin, and stimulate perspiration; they flush the kidneys, and assist in removing the products of tissue metabolism, and in other ways tend to lower the temperature. (*b*) The **secretions of the stomach and bowels** are likewise deficient in quantity and quality. If the patient could eat meat and other substantial viands, it would not be proper for him to do so, for the digestion of these substances would be difficult and slow, and in all probability indigestion or gastric catarrh would be induced. An abundance of nutritious and easily-digested food is essential to provide for the daily losses; an adult may have 4 to 5 pints of milk, and 1 pint of beef-tea, veal broth, chicken, mutton, or rabbit broth daily. The soup or milk may be thickened in some

cases with arrowroot, fine oatmeal, revalenta; blancmange, custard, jelly, and raw eggs may be given in alternation. When milk disagrees, it may be mixed with an equal quantity of lime, barley or soda water, or it may be peptonized by the use of liquor pancreaticus or peptonizing powder. In rare cases milk cannot be retained at all, and a temporary substitute is found in albumin-water; beat up the white of an egg, and mix it with a teacupful of lemon-water. Various meat essences are under such circumstances very useful. (*c*) **The heart and circulation** may need stimulation, for which purpose tea and coffee are suitable; they should be made strong, and afterwards diluted with hot milk. They stimulate the heart, rouse torpid nerve centres, and are diuretic. Lemon-water or lemon-juice is a sedative to the heart, and reduces the rapidity and force of the pulse. Alcohol is rarely needed when the pulse is less than 100 per minute; but if it is quick (115, 120, or more), feeble, irregular, and the first sound inaudible, alcohol is necessary. Its necessity is accentuated if the tongue is dry, brown, and tremulous, or there is a low muttering delirium; from 2 to 4 ounces of brandy or whisky may then be given in divided doses in twenty-four hours, its effects being carefully watched. Collapse may be met by giving some form of alcohol or coffee, and in bad cases by slapping the face with a wet towel or rhythmic traction of the tongue. Coldness of the extremities may be due to feebleness of the circulation or collapse, and the limbs should be rubbed with dry mustard or ginger, warm bottles applied to the feet, and a warm wrap put around the limbs.

Special Forms of Pyrexia.—It will be a sufficient guide if two types are discussed, rheumatic and enteric fevers, for the lines of general treatment are the same in all cases.

(*a*) **Rheumatic Fever, Acute Rheumatism.**—In the acute stage the diet should consist of 4 or 5 pints of milk, as in other diseases; but, on account of the profuse acid perspiration, the milk should be diluted with an equal quantity of water or barley-water, to each pint of which half a teaspoonful of bicarbonate of soda and a quarter of a teaspoonfnl of common salt are added. Iced lemon-water, also containing a little soda or potash, may be taken freely. A little thin gruel made of oatmeal may be given several times a day, but as a rule very little is required but milk during the acute

stage. The patient should be absolutely at rest, and lie upon a thin blanket over a soft mattress; he should be covered by a sheet and other bedclothing according to necessity. The shirt or gown should be made of woollen material or flannelette: it should be made to open all down the front; the sleeves should be made to open from the wrist to the elbow. The joints should be wrapped in wool, and may have an alkaline lotion applied to them; the knees and ankles will be more comfortable if protected by a cradle. The use of a bed-pan is absolutely necessary.

When the acute stage has passed off, the patient may have some clear soup or broth flavoured with vegetables, the salts of which are valuable for the disease. We may also add to the diet a little stale bread-and-butter, pounded meat or chicken, milk pudding, bread-and-milk, custard, blancmange, junket, jelly, and a few grapes or strawberries. After the temperature has remained normal for a day or two, we may give experimentally a poached egg or one of the lighter kinds of fish; if these are borne without discomfort, we may also add a little chicken, game, mashed potato, cauliflower, spinach, or vegetable marrow, after which he may gradually return to the ordinary diet.

(*b*) In **enteric fever** the patient must be confined to bed, a hair bed and spring mattress being the most suitable. The bed-clothing should be as light as is consistent with warmth; too much clothing would prevent the radiation of heat and evaporation of moisture from the body, and tend to keep up the high temperature. During the course of the disease the patient's body should be frequently sponged with cold or tepid water, to reduce the temperature. Cold baths are also valuable for the same purpose; and frequent tepid baths (75° to 85° F.) reduce both the temperature and the dangers arising from the disease. A single bath reduces the fever, headache, stupor, or delirium; under its influence the pulse becomes firmer, thirst is diminished, and the patient feels relieved. The effect of a bath is, however, only temporary, and it should be repeated when the temperature again rises to 103°. This course of treatment entails some trouble to the nurse, and sometimes patients dislike it, but it is worth all the trouble and inconvenience to the patient. Cold wet packs and cold sponging are less trouble, but they are also less efficient. When a course of cold baths is regularly adopted, there is less

risk of hæmorrhage from the bowels and pneumonia; but the existence of these complications is a contraindication to their use. Hæmorrhage from the bowels may be controlled by giving the patient ice to suck and placing an ice-bag or ice-water compress over the abdomen. Tympanites may also be reduced by giving ice to suck, by applying an ice-bag or compress over the abdomen, or by injecting turpentine into the rectum.

The food should consist almost entirely of milk. Five pints of milk in twenty-four hours will nearly supply all the elements which the body needs; this quantity is quite easily consumed by most persons if it is divided into small meals of $\frac{1}{4}$ pint each. If milk is badly borne by the patient, it should be peptonized, and various preparations of casein, or milk powder, and koumiss can be used with advantage. Two or three eggs may be given daily in the milk; and a pint of beef-tea, chicken broth, mutton broth, or clear soup can also be given. Beef-tea sometimes causes diarrhœa, but chicken and mutton broth do not.

Farinaceous foods, especially arrowroot and cornflour, may be combined with milk and the white of eggs in proportion to the diarrhœa; the starch in these foods will probably not all be digested, but it will assist in controlling the diarrhœa, and is valuable to that extent. Nutmeg and cinnamon are pleasant flavourings for farinaceous foods, and are also of value in checking the diarrhœa. The yolk of eggs should not be given if the diarrhœa is severe and persistent. When there is marked constipation, we may give more beef-tea and raw eggs; but the cornflour and arrowroot should be replaced by 2 or 3 ounces of fine oatmeal daily. Many authorities forbid farinaceous food in every case of enteric fever, but I am convinced of the value of their judicious and moderate use. An eminent physician prescribed the following diet for a case of enteric with diarrhœa: 8 pints of milk daily, thickened with cornflour, arrowroot, or a patent food; also a little boiled stale bread with milk, a small piece of sponge cake or Madeira cake, the white of eggs, custard and jelly.

Whenever the patient takes milk with difficulty, it should be mixed with lime-water, barley-water, tea, coffee, or cocoa. The white of eggs mixed with lemon-water is much relished by patients, and is partially a substitute for milk.

The patient cannot be allowed *coarse* oatmeal, vegetables, and fruit, but the juice of an orange, lemon, or grapes may be taken ; thirst may also be quenched by sucking a small slice of lemon occasionally.

The patient should be kept on fluid food until the temperature has been normal for ten days ; only in mild cases should the rule be relaxed. During convalescence the solidity of the food may be increased daily. We may gradually add mashed potato, custard, junket, jelly, blancmange, boiled bread-and-milk, sponge cake, Madeira cake, roasted apple, stewed rhubarb, and purée of parsnip or other vegetables. After these soft foods have been given, and it is ascertained that they can be taken with impunity, a little pounded beef or chicken, sole, plaice, whiting, or other light fish, then a slice of fowl, pheasant, or mutton, may be added in the order named.

Care must be taken with regard to the use of purgatives ; their use is best avoided for some time, or until convalescence is thoroughly established, enemata being used when requisite.

Malarial Fever.

In tropical countries malarial fever is apparently brought about by slight causes, especially in certain districts—a catarrhal cold, a slight exposure to the sun when not properly protected from it, a tedious journey, a slight injury, or an indiscretion in eating or drinking, appear to induce it. But it is known that these are not the absolute causes of the fever. Malarial fever is due to a parasite (the *Plasmodium malariæ*), an amœba which lives in human blood and becomes encapsuled in the red blood cells. It is introduced into the body by means of water or the mosquito. There are several kinds of the parasite—one which gives rise to a tertian, another to a quartan, and others which cause fevers of a pernicious character, which occur chiefly in the spring or autumn. Such fevers are most common near the marshy banks of rivers, the bed of rivers, salt or fresh water marshes which are drying up, on lands which are subject to periodical inundation, at the base of mountain ranges, in jungles, in arid, sandy, or barren districts which have a moist subsoil or red sandstone rocks or ferruginous earths which retain moisture, and in

volcanic and certain hill districts. Thus, in England they occur in the fens of Cambridge and Lincolnshire, along the banks of the Thames in Kent and Essex ; on the west coast and Campagna of Italy ; the flat districts of North Germany and Holland ; the west coast and many other places in Africa ; many places in Asia, both on the Continent and the numerous islands of the Indian Ocean ; and in India along the Ganges and the Indus. It occurs also in certain hill districts, as the Apennines and Pyrenees in Europe, in Peru and India ; but the factors are practically the same as in the marshes—a loose porous soil resting upon a firm basis of clay or rock, so that it retains the water. A combination of moisture, heat, and vegetation is necessary for the production of the miasm, which occurs very largely during the hot, moist seasons. Remittent and irregular fevers are always present in malarial districts. In India the quotidian fever is most general from June to October, especially in those districts where the south-west monsoon brings the rain ; but the tertian fever is most common in the cold season. The specific cause of malaria is not merely wet and damp, for fevers sometimes disappear from a district during the height of the rainy season ; nor is it altogether due to decomposition of vegetable matter ; but a combination of damp, porous soil, rank vegetation, and absence of cultivation favour it extremely. Swampy and damp areas which are irrigated, drained, and well cultivated, lose their malarial properties and no longer give off a miasm. But if such districts be again neglected and allowed to go out of cultivation, they revert to their former condition, and a bad form of fever may prevail.

There is little doubt the mosquito is an important agent in spreading the disease in two ways : it may do it directly by sucking the blood of a fever patient, and afterwards biting a healthy individual, when some of the spores will be injected into him ; but it also acts as an agent in the development of the parasite, which is one of those forms of life which require to live in the body of two different animals to complete their growth. In the human being the plasmodium or amœba becomes encapsuled in the red blood cells, where it enlarges, and destroys the hæmoglobin or converts it into black pigment. The development of the parasite is marked by its segmentation into about sixteen or twenty spores, which occupies two or three complete days.

The blood cell then bursts and sets free the spores and blood pigment in the plasma. The spores enter other red blood cells, and each crop is the cause of a fresh attack—tertian or quartan, according as two or three days are occupied in their growth. Now, when a mosquito bites such a person, it draws into its stomach some of that person's blood, whose cells contain the amœba. In the stomach of the insect the amœba becomes transformed into another form of the parasite, which is capable of sexual impregnation. One of two things happens: the insect visits the marshes, pools, or puddles of water and moist, damp places to lay its eggs. It often dies there, and the amœba becomes liberated and lives in the water, whence its passage into the human body may occur in many ways. While the amœba is in the body of the mosquito, an abundance of spores are formed by it, which, floating in the tissues and blood of the insect, reach its salivary glands, and are thence transmitted to human beings with each bite or puncture of the mosquito. Such spores enter the red blood cells as before, and give rise to the amœboid bodies first mentioned, which undergo division by segmentation.

The segmentation of the amœba in the blood cells corresponds with the beginning of the paroxysm or ague. The symptoms are usually preceded for three to twelve days by headache, pain in the back and limbs, nausea, discomfort at the stomach, chills and flushes of heat, sometimes irritability or a feeling of elation, brightness, or unusual cheerfulness; then the ague fit sets in, and consists of three stages, which succeed each other.

In the cold stage the patient feels chilly, creeps near the fire, or walks in the sunshine. This frequently develops into a marked *rigor*, during which he curls himself up, shivers all over, his teeth chatter, his skin is blue and pinched, and looks like goose-skin. The surface of the body may actually feel cold, but a thermometer in the mouth or under the arm shows it to be above normal. It may last half to two hours, the temperature rising as it gradually passes into the *next stage*. **The hot stage** is marked by a sensation of heat and dryness of the skin over the whole body, flushed face, throbbing eyes and head, and tendency to delirium, which may last four to six hours, the temperature rising to 103° or 105° or more. **The sweating stage** now sets in,

and is evidenced by beads of perspiration on the forehead, and a moisture gradually spreading over the body. The pains and discomfort are relieved, thirst is checked, temperature gradually falls, and there is a return to the normal condition, and, excepting weakness, he feels perfectly well. The same things may, however, occur again the next day (quotidian), or in two days (tertian), or in three days (quartan), when it is called intermittent fever. The stages, however, are not always so well marked as that. The cold stage may be very short, and the hot stage last a day or several days, when it is called remittent fever, or tends to become a continued fever. There are variations of this also, as gastric remittent, when there is vomiting of watery fluid containing bile; bilious remittent, with vomiting, purging, and jaundice of the eyes; cerebral remittent, manifested by much delirium, convulsions, or coma about the third day, and distressing hiccough; and typhoid remittent, when the disease runs a course similar to enteric fever. **Black-water** fever is a form of fever in which the urine is black, owing to its containing a quantity of colouring matter derived from the destruction of red blood cells by the parasite; in some cases the kidneys are very badly congested, and the urine then actually contains blood. Other troubles are malarial diarrhœa or dysentery, malarial ulcers following pimples on the hips or lower limbs, affections of the liver and spleen, anæmia, and affections of the nervous system, as headaches, loss of memory, neuralgia, and paralysis.

The *prevention* of the disease is an important matter, and depends upon living in a suitable position, protection of the house by wire gauze to windows, regular use of mosquito-nets, destroying mosquitoes or their eggs and larvæ by pouring kerosene upon the surface of the pools and stagnant waters in which they breed, cultivating and draining the land, and planting upon it eucalyptus trees, especially the blue-gum, and trees of the genus Cinchoneæ, which are evergreen and readily flourish wherever malaria abounds. Attention to personal hygiene is likewise important, such as regular meals, eating proper food, especially fat, which feeds the cells that destroy disease germs, and avoiding an excess of alcohol, which destroys the microbe-eating cells. Coffee is believed to be the best beverage, and its regular use is highly spoken of as a preventive measure. Attempts at immuniza-

tion by arsenic, quinine, and other drugs have not been very satisfactory.

Food and Hygiene.—At the earliest sign of fever, coldness, and shivering, the person should go to bed and be well covered with blankets and rugs, have hot-water bottles to the feet, sides, and abdomen, and be briskly rubbed under the bedclothes from the feet upwards. Warm drinks, such as hot tea and coffee, help to shorten the cold stage. Headache may be relieved by applying cold-water cloths or cold spirit lotions to the head, or leeches to the temples. Vomiting is common, and is beneficial if the tongue is foul. If it is very severe it may be checked by a mustard plaster over the pit of the stomach, by ice to suck, or a little brandy-and-soda or champagne ; by citric or tartaric acid, or lemon-water or lime-juice, which also help to allay thirst. If, on the other hand, the patient has *not* vomited, and the fever came on soon after a meal, it is proper to induce vomiting by tickling the throat with a feather, or giving an emetic, such as salt and water or mustard and water. It is also often necessary to give an aperient at once, for which purpose seidlitz-powders or a saline aperient water may be given, and repeated daily *until the evacuations are normal and healthy.* Further purgation may induce diarrhœa or contribute to the production of gastric irritation.

During the hot stage remedies which will promote perspiration and act upon the kidneys are proper ; at the same time the temperature may be lowered by frequently sponging the body with tepid water or vinegar and water. Food should consist of soup, beef-tea, hot milk, farinaceous materials ; and stimulants such as coffee, with wine or brandy if the depression is very great. Delirium or low muttering is quite common, and need not occasion alarm. It is best met by cold applications to the head and frequent bodily sponging, with a blister or mustard plaster at the back of the neck, or a few leeches behind the ears. If, however, there are convulsions, he should be put into a warm bath of about 100° F., gradually cooled by addition of water, at the same time applying cold to the head. If there is unconsciousness, or he snores and cannot be roused by any means, and the face is flushed, it is most likely that there is some pressure upon the brain, by hæmorrhage or otherwise, and this view will be favoured if we are quite sure that the unconsciousness is not due

to opium or alcohol. We must then apply ice to the head, mustard plasters to the soles of the feet and calves of the legs, and raise the end of the bed so that the upper part of the body is elevated, and the return of blood from the head is favoured. Persistent unconsciousness may necessitate the use of the catheter to draw off the urine, and feeding by the bowels with beef-tea or raw egg and milk. As soon as the intermission begins, quinine, alone or with salts, will be administered in two- or three-hourly doses until the next exacerbation is expected, which is sometimes delayed or checked by hot coffee or hot water and spirits.

In the remittent form, the method of procedure is very similar to the foregoing, the object being to produce warmth in the cold stage, and perspiration or evaporation from the body in the hot stage. In the typhoid form, the feeding and nursing should be the same as in enteric.

In black-water fever the patient should be kept warm and comfortable; then, with proper drugs, he may be considered as progressing favourably so long as the urine is free; but if this is not free, or is suppressed owing to congestion of the kidneys, it will be absolutely necessary to relieve them of their congestion by acting powerfully upon the skin. This may be done by hot packs, by hot fomentations of mustard over the loins, by vapour or hot-air baths (see 'Acute Bright's Disease'). Hot mustard baths are useful; the patient sits with his feet and legs up to his thighs in hot water and mustard for half an hour at a time, the body and bath being enveloped with blankets, so that he is well steamed. The hands and head are kept cool by frequent bathing or cold sponging; and in the intervals between the bath he is wrapped in hot packs, or hot fomentations are put across his loins. The food should consist of milk, which will not irritate the kidneys, and large quantities of barley-water or oatmeal-water, which will soothe them and help to clear them. A little arrowroot and milk, or banana flour and milk, or egg-flip is also suitable, *but no beef-tea* or other animal broth can be allowed until the urine becomes clear, limpid, and normal, when we may also add chicken broth, milk pudding, and later on fish and fowl. Sudden syncope occurring in any of these forms of fever, as shown by collapse, thready pulse, coldness of skin, and sunken features, requires heat to the body, hot drinks and stimulants.

Complications occurring in the chest, or abscess of the liver, may require poultices and other suitable treatment.

The effects of malaria require to be mentioned. Malarial diarrhœa produces a sense of relief instead of suffering, and it may occur in place of an attack of fever—in fact, the poison is being thrown off by the bowel; therefore do not give astringents unless the purging be excessive, say more than seven or eight movements a day, or it lasts a long time; but give a food consisting chiefly of milk—cornflour, arrowroot, banana flour, other fine meal, white of eggs, isinglass jelly, milk jelly, blancmange. If there is much pain, poultices to the abdomen will give relief.

Malarial dysentery is similar to true dysentery, only it is due to malarial poison affecting the bowel and causing discharges of blood and mucus; it would be unwise to stop it at once, because Nature is relieving herself this way. Keep up the strength by giving milk and white of eggs, milk and lime-water, arrowroot, cornflour, sago, tapioca, rice milk, and chicken broth, all to be given warm.

Malarial headache, insomnia, neuralgia, enlarged spleen, require quinine and nourishing food; and malarial cachexia or anæmia necessitates a change to another locality, or perhaps a long sea voyage.

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CHAPTER XXI

DISEASES OF THE STOMACH

FUNCTIONAL DISORDERS OF THE STOMACH.

INDIGESTION, or dyspepsia, is an imperfect solution of the food by the gastric secretions, attended by pain or discomfort, when its origin is independent of changes in the structure of that organ; it is the result of eating indigestible food, improper mastication, hurried eating, or some abnormal condition of the gastric secretion,

or of the motility of the organ. It is likewise a necessary result of gastritis, gastric catarrh, and other organic affections of the stomach.

Acute indigestion, for example, occurs when a healthy individual takes a larger meal than his stomach can bear, or consumes substances which are of an indigestible nature, or which his stomach is unable to digest owing to bodily exhaustion. In such an instance, the offending substance causes pain at the pit of the stomach, or perhaps some disturbance of the heart, and restlessness; if the patient sleeps, he may have troublesome dreams, and when he awakes will probably have an unpleasant taste in his mouth, disinclination for food, and a headache. In other persons the indigestible substance causes vomiting, which relieves the symptoms by removing the offending material; the vomiting may, however, last for some hours, and be attended by regurgitation of bile and followed by purging. Sometimes the food eaten induces spasm or cramp at the stomach. When the pain is severe and the cause is obvious, an emetic is the proper remedy. The stomach should rest from food until the distressing symptoms have subsided, when a light meal of milk and soda-water, milk pudding, or bread-and-butter with a cup of tea, may be taken; then light fish or chicken may be eaten before returning to the ordinary diet.

Chronic indigestion is caused by a continuance of improper food, indigestible food, such as coarse meat, salted or dried meat, pork, veal, game, hashed meat, rich or highly-seasoned food, stringy or fibrous vegetables, hard fruit or nuts; by an excessive consumption of food, hurried eating, or imperfect mastication. All organic affections of the stomach are also causes of indigestion; but apart from these, there may be an excess or deficiency of hydrochloric acid, pepsin, or mucus. Atony of the stomach, constipation, general illness, and all causes of low vitality, also affect the gastric secretion and motility.

Dyspepsia and functional derangement of the stomach are very common in tropical and subtropical countries; it may then be of a simple form, such as is easily relieved by ordinary medicines and careful dieting; or it is due to defective secretion, malassimilation, and consequent debility of the nervous and muscular systems, and may need a change of air or climate to

prevent the development of **tropical cachexia.** Many individuals with feeble digestive power are simply martyrs to indigestion so long as they remain in a hot climate. The cachexy, referred to as being due to a tropical climate, is brought about by loss of appetite, diseases of the stomach, liver, and spleen, a tendency to scurvy, anæmia, and malaria, prolonged heat, excessive moisture, profuse perspiration, sleepless nights, and sudden chills. These conditions produce debility, accompanied by impaired digestion, palpitation, a pale, bloated, and sallow countenance, a pearly lustre of the eyes, wasting of the body or fat flabbiness, skin eruptions or dryness and roughness of the skin, aching of the limbs, disinclination for exertion, mental depression or irritability, and indifference to the future.[1 2]

The **treatment** of functional derangement of the stomach depends somewhat upon the conditions which are associated with it. Although subjective symptoms are not to be despised, it is sometimes necessary to make a physical examination of the stomach and its contents. The *motility* of the organ can be ascertained by the use of Riegel's test-meal, which may consist of definite quantities—say, 100 c.c. of soup, 60 grammes of beef steak, and 50 grammes of white bread. This should wholly disappear from the stomach in five hours, and leave no trace in the liquid which can be drawn off at this time with a stomach tube; and the amount of food which can be drawn off five hours after such a meal may be taken as a measure of the deficient power in the stomach to discharge its contents into the bowels. The *acidity* of the stomach is likewise determined by the use of the Boas-Ewald test-meal, taking for breakfast a dry bread roll and $\frac{1}{2}$ pint of tea or a glass of water, and drawing off the contents one hour after, when digestion is at its height. The total acidity is determined by its neutralization with an alkali; *free* hydrochloric acid is tested for, and likewise lactic, butyric, acetic, or other organic acids.

It is found by such examinations that in atony of the stomach the power to discharge the meal into the intestine in a proper time is defective, and that there is frequently a deficiency in the proportion of hydrochloric acid, which is called **hypochlorhydria.** In other conditions of the stomach there is an excess of this acid, and the condition is then called **hyperchlorhydria**; or an abundance of organic acid is found, which gives rise to **organic**

acidity. Each of these is sometimes described as the actual functional derangement of the stomach.

Hypochlorhydria—that is, too scanty or too poor a quality of gastric juice—is very common in the atonic dyspepsia of elderly persons, partly from lack of material for its formation and partly from diminished excitability of the mucous membrane. Deficiency in the muscular tone of the organ may lead to imperfect mixture of the food and secretion, with consequent indigestion. It also occurs in atony of the stomach in other individuals, and is frequently associated with anæmia, chlorosis, and chronic gastric catarrh. The symptoms are similar to those of gastric catarrh, which may complicate it; the appetite is poor, there is little pain after food, a good deal of fulness from flatulent distension, and eructation of sour, rancid liquid or gas, and the contents of the stomach often contain lactic and acetic acids or yeast fungus; there may be vomiting of food which is scarcely digested at all, and diarrhœa or constipation. The tongue is usually clean, taste unchanged, and breath free from smell; but the tongue may be flabby, the taste bitter, and the breath foul.

In **hyperchlorhydria** the gastric juice is abnormally strong, and it is usually accompanied by dyspeptic symptoms; it is often a primary disease, and occurs in about half the people between twenty and forty years of age who have dyspepsia; it is more common in men than women, and especially in those who smoke or drink to excess. When it exists, starch is digested slowly and meat quickly; starchy foods increase the pain, but meat gives temporary relief. The specific characters of hyperchlorhydria are an abundance of gastric juice, having a high percentage of acidity at the height of digestion, due to *free* hydrochloric acid; there is little mucus usually, the appetite is not impaired, and there is perfect comfort during a meal and for some time after it. But in an hour or two a feeling of discomfort arises, with heartburn, more or less pain, eructations of gas, and water-brash; there may be headache, giddiness, or nausea, and constipation is not uncommon. The motility of the stomach is not interfered with; a small meal disappears in two and a half or three hours, and a large one in five or six. When the stomach is empty there is freedom from discomfort.[3]

Organic acidity occurs in many cases of dyspepsia, and is some-

times a primary disease ; its origin is **simple** when the acidity is due to the transitory presence of acids in the food, as vinegar, pickles, salads, cider, and other acid drinks ; **fungoid** when it is due to the existence in the stomach of penicillium, aspergillus, and other fungi ; or it may be **bacterial**. The acids mostly developed are acetic, lactic, carbonic, and butyric ; their presence in quantity causes heartburn, water-brash, regurgitation of food, wind, flatulent distension of the stomach, cramp, spasms, palpitation of the heart, shortness of breath, and sometimes vomiting. When **fungi** are the cause of the trouble, the vomit may be red or green, which gives it the appearance of blood or bile.[1]

In the treatment of all functional derangements of the stomach the teeth must receive attention and all defects must be made good ; mastication must be slowly and carefully performed ; there should be a short rest before meals and a longer rest after them ; and proper intervals must be observed : they should not be too near. Most persons who suffer from these ailments require five or six hours for the complete digestion of a good meal, consisting of the ordinary solids, and fully six hours is required by the aged and invalids. The consideration of the quality of the food is of vital importance. If the indigestion is very *severe* the treatment should be begun by keeping the patient upon milk diluted with an alkaline or gaseous water, or peptonized milk, milk gruel, or other farinaceous foods, soups, jellies, and custard. *If less severe*, or while attention is being given to defective teeth, we should allow only such foods as require little mastication, as the crumb of stale bread, dry toast, biscuits, such as cracknel or others which readily break down to a powder in the mouth, soup, broth, purée, consommé,* pounded or scraped meat, light fish, mashed potato, and milk puddings.

In cases where the stomach is unable to digest proteids, owing to deficiency of the gastric juice or of its acid or ferments, proteids should, for a short time, be given in a prepared form, such as casein preparations, peptone, or semi-digested albumin. The free use of salt, by helping to form hydrochloric acid and check fermentative processes, is useful. The starches and other

* *Consommé* consists of meat and vegetables boiled together for a long time, until the whole is reduced to a pulp or jelly of moderate consistence ; for some persons it is very necessary, even after being so reduced, to pass it through a fine sieve to remove indigestible fibrous substances.

carbohydrates are usually well digested. On the other hand, if there be hyperacidity the proteids are exceedingly well digested, but carbohydrates are feebly acted upon, so that malted food and others containing maltose and dextrin are for a time serviceable.[5] Artificially digested foods should not be used for a long period, but only while the stomach is permitted time to recover its tone and function in a certain degree. In all ordinary cases we may allow: **Bread** which is good and stale. New bread should never be eaten: it forms tough masses, like putty, in the mouth, which resist the action of the digestive secretions; good stale bread is light and porous, crumbles easily in the fingers, and does not form coherent masses when chewing it. Clear, thin **soup** of beef, mutton, veal, chicken, turtle or clam, and purée or consommé, are suitable. Light **fish** may be allowed, as sole, plaice, haddock, whiting, brill, turbot, flounder, chad, perch, or bass; heavy kinds of fish, as salmon, mackerel, hake, eel, conger-eel, etc., should be avoided; it may be eaten with cold butter or lemon juice, in preference to rich sauces. Tripe and sweet-bread, being easily digested, are suitable; chicken, pheasant, grouse, rabbit, are more suitable for these persons than the dark flesh of hares, venison, and other game. Mutton is better than beef, while pork and veal should be rejected. When eating any kind of fleshy food, no matter what its character, it is necessary that the dyspeptic person should remove all skin and every particle of gristle, because it is impossible for a weak stomach to digest such material, and their presence in it causes much pain and increases the ailment. Potatoes are better when thoroughly mashed; and vegetables, like cabbage, savoy, kale, brussels sprouts, can only be allowed when reduced to a purée, after cooking, by rubbing them through a hair sieve. Cauliflower, spinach, vegetable marrow, squash, kidney beans, and green peas, may be eaten in the ordinary way when they are tender and well cooked. The relative duration of time required for the digestion of starch varies with its source. Grierson[6] has shown that the root starches are more quickly digested than those derived from cereals; thus, arrowroot and potato starch are converted into sugar and digested in about ten minutes, tapioca in thirty minutes, and oatmeal in eighty minutes, whereas rice, maize, and wheat flour require two hours for their conversion and complete digestion, from which we gather that

arrowroot, tous-les-mois, potato, and tapioca are the best sources of carbohydrate for a weak stomach. Oatmeal and wheat flour are rendered more easily digested by long cooking, whereby the starch granules are thoroughly softened and some of them converted into dextrin. Dessert may consist of junket, jelly, custard, blancmange, egg-snow, milk puddings, and well-cooked fruit, such as apples, plums, and prunes.

What to Avoid.—All kinds of rich food, inasmuch as they will cause indigestion, should be scrupulously avoided: rich soup, gravy, or sauce; veal, pork, sausage, goose, duck, fried eggs, fried fish, and other fried foods; forcemeat; liver, kidneys, brain; hot buttered toast, crumpets, muffins, pastry, boiled puddings, cakes; pickled and salted meat; crab, lobster, shell-fish; cheese; sweetened dishes, jam, and confectionery. Pastry, buttered toast, and greasy food, like pork or duck, are indigestible because the fat is so intimately blended with the fibres of the meat and the flour in the pastry or cake that the gastric juice cannot act upon the albuminoid materials until the fat has been removed; fat is not digested in the stomach, but only in the intestines whence these foods must pass before they are digested, unless they remain in the stomach a sufficient length of time for the complete removal of the fat which invests them, during which time pain, acidity, and other distressing symptoms occur. Salted or dried meat, like ham or bacon, is less easily digested than ordinary fresh meat. Dyspeptics should not eat uncooked vegetables, salads, pickles, fruit, or nuts; nor fibrous vegetables, like cabbage, savoy, kale, turnips, carrots, parsnips, yam, sweet potatoes, or manioc, unless previously reduced to a purée by passing them through a fine sieve. When acid fermentation is a marked feature, by which is meant the production of lactic, acetic, carbonic, or butyric acids, it is proper to diminish the amount of carbohydrate food for a time, and limit the dietary to milk, fish, chicken, tender meat, a little dry toast, and spinach or vegetable marrow, which foods can, however, be varied in many ways. Hyperchlorhydria is also sometimes treated by forbidding starchy foods (their digestion being interfered with, because the excess of acid prevents the conversion of starch to sugar), and giving only proteid foods; other practitioners forbid meat because it increases the gastric secretion, and allow only starchy foods and milk. But in all cases

of acid dyspepsia, whether of organic acidity or hyperchlorhydria, the simplest diet is the best, and we may safely allow boiled or poached eggs, bread-and-butter, tender meat or poultry, light kinds of fish, easily digested vegetables, and milk puddings. Butter checks the secretion of gastric juice, and helps in the nutrition of the body.[7] Dyspeptics of all kinds should eat only three meals a day, and at long intervals—breakfast, lunch, and dinner; the last meal should be two and a half or three hours before going to bed. The patient should retire to bed early, and lie upon the right side, to assist the stomach in emptying its contents into the intestines. It is incorrect to drink tea with a meal containing meat, as the albuminoids are hardened by the tannin, and digestion is thereby hindered. Excess of tea, coffee, alcohol, and tobacco must be avoided. It is better not to drink anything with the meal; but a good draught of hot water half an hour before the meal dilutes and washes away the remains of the previous one, and refreshes and prepares the stomach for the next. The soup, which is taken at the beginning of dinner or lunch, when in small quantity, serves as a useful stimulant to digestion; and in atonic dyspepsia a small quantity of sound wine or well-diluted spirit at the close of the meal serves the same purpose. A cup of tea, coffee, or hot water, taken three or four hours after a meal, will hasten the final stages of digestion; but if food be taken with it it will prove a hindrance rather than a help. Tobacco is a well-known cause of indigestion, and the amount should be limited to the consumption of 2 ounces of mild tobacco a week, smoked in a pipe.

The use, and especially the abuse, of artificial digestants should be discouraged; the stomach is to be properly treated, and only given such work as it can perform without their aid. There is sometimes a deficiency in the quantity or quality of the saliva in dyspepsia, and the ferment may be absent; when such is known to be the case preparations of malt, given before or about two hours after a meal, will be a valuable assistance in the digestion of farinaceous or starchy foods. Sialagogues may be given to increase the secretion of saliva, as horse-radish sauce, ginger, pepper, and other aromatics. Salivary digestion is interfered with by taking vinegar, pickles, mint sauce, and acid wines, such as sherry or claret, with the food, and tea checks the secretion to

some extent. Starch digestion goes on in the stomach so long as free hydrochloric acid is absent; for this reason bread and similar articles are digested more readily when taken along with meat or other proteid which the acid may attack.

The increased consumption of cane-sugar in many forms is one cause of the digestive troubles of the present age. 'Sugar' is converted in the stomach into glucose (maltose) by the gastric juice acting in the presence of mucin. But the frequent presence of sugar in the stomach causes a disproportionate increase of the secretion of mucus; the latter is often so profuse as to envelop the individual portions of food and prevent the gastric juice from getting to them, to the hindrance of proteid digestion. Furthermore, the experiments of Aitchison Robertson[8] prove that the power of the stomach to convert cane-sugar to glucose is very much diminished in chronic gastric troubles; that cane-sugar causes pain in the stomach, and heartburn, flatulence, or vomiting, when taken in solution after washing out the organ; but solutions of invert-sugar do not cause any discomfort. This evidence shows that jam, marmalade, and ordinary sweetened dishes should be avoided by dyspeptics, because they will increase their trouble; but honey, treacle, golden syrup, and other substances containing invert-sugar in large proportion do not cause pain or increase dyspepsia; they are rapidly absorbed, and may be used by dyspeptics of all kinds, and are of especial use for children in the nursery.

When persons have been accustomed to the free use of spices, condiments, or other stimulants, by which the mucous membrane has been excited, their use must not be stopped too suddenly. The result would be a very scanty secretion of gastric juice, because the ordinary foods are not then a sufficient stimulus to the secretion of an adequate supply of the digestive fluid in an organ which has become accustomed to such powerful stimulation; consequently, part of the food would remain undigested, and the symptoms of atony with hypochlorhydria develop. On the other hand, if the use of strong irritants, such as pepper, cayenne, horse-radish, pickles, and curries, be continued, the digestion and nutrition will go on all right for a time, but chronic gastric catarrh will probably follow. We cannot, therefore, recommend the continued use of spices and condiments in undue quantity, nor to

stop their use suddenly; either course would probably end in a breakdown of gastric digestion. The bad habit, for such it is, as much as excessive drinking or smoking, must be broken gradually.

Lavage, or washing out the stomach, is sometimes very beneficial; it is best done at night on going to bed. By washing out the cavity and removing from it all remains of food we can give the stomach eight or ten hours of complete rest. Lavage of the fasting stomach is also useful; it refreshes it, clears away mucus, washes the mucous membrane, and prepares it for the day's work. A cold compress worn over the stomach and fastened on with a flannel bandage through the night is also useful; when it is removed in the morning the chest, abdomen, and back should be sponged with cold water, and briskly rubbed with a rough towel.

It is necessary for the invalid to give up sedentary habits or occupations, and take exercise in the open air daily; to remove from town to country or seaside, and lead a perfectly regular life. A tour in Scotland, the Tyrol, Switzerland, or other mountainous region, works wonders. The tropical resident may need a change of climate or a long sea voyage, and a pure mountain air is just what is needed by the person with tropical cachexy; but even under the best conditions it may take months or years for him to recover health and vigour.

A course of the mineral waters at Bath, Leamington, Malvern, or Harrogate, in England; at Carlsbad, Marienbad, Kissingen, or Tarasp, on the Continent; at Hot Springs, Arkansas, at Bethesda, and similar sources of water in the United States, would be valuable by promoting the abdominal circulation, stimulating the glands of the stomach, intestines, and the liver, by washing the mucous membrane, checking fermentation, and removing fungoid and bacterial growths, and eliminating the products of imperfect digestion, which so often cause headaches, giddiness, and hypochondria in chronic dyspepsia.[9] A course of baths of these mineral waters, combined with massage, douching, galvanism, change of climate, and exercise in the open air, are important factors in spa treatment.

The digestive troubles of infants and young children are chiefly due to feeding them with substances of improper composition, an abnormal quantity of food, irregular feeding, improper tem-

perature at which the material is given, or micro-organisms in it. Improper feeding is responsible for indigestion, catarrh of the stomach and bowels, gastric dilatation, colic, and vomiting. Colic is a distressing symptom, often of gastric origin or due to flatulence from the generation of gases by fermentation of the food ; in many instances, also, it is due to the presence of tenacious mucus, which interferes with digestion and the exit of food from the stomach. Micro-organisms in food act by directly irritating the mucous membrane, or inducing fermentative changes, thereby causing many attacks of acute or chronic catarrh, indigestion, cholera, diarrhœa, colic, and vomiting. These troubles can only be prevented by great care in the preparation of food, by giving it in proper quantity and quality, and by other hygienic treatment (see also 'Feeding of Infants' and 'Acute Gastric Catarrh').

Atony and Dilatation of the Stomach.

The sufferer from atony and dilatation, in addition to the symptoms of indigestion, has usually a worn and anxious appearance, and is thin and pale. Weakening of the muscular tissues of the stomach and chronic gastric catarrh are factors in the production of the disease. It may follow long-continued indigestion, excessive use of tobacco, tea, coffee, or other stimulant, or a long illness, such as the infectious diseases, anæmia, chlorosis, prolonged suckling in women, prolonged overwork, insomnia, diseases of the nervous system, or other diseases which interfere with the nutrition of the organ. Excessive eating and drinking are causes of dilatation, and so is excessive flatulence when the contractile power of the organ has been weakened by disease. Its origin may, however, be due to spasm of the pyloric valve from chronic irritation of the stomach, to atony of the muscular walls,[10] to obstruction by a stricture, ulcer, or cancer of the pylorus, or the presence of foreign bodies, such as masses of hair or a plumstone; pressure from without may also cause it, as gall-stones, bands, and adhesions, or displacement of the kidney.

The patient suffers pain and discomfort from the gradual accumulation of food and secretion for several days in the dilated and weakened organ, which is temporarily relieved by

vomiting. The manner of vomiting is characteristic of the disease, the contents of the stomach being 'pumped up' without feeling of nausea. The vomited matters are foul, fermented, and contain undigested food eaten days before, together with various bacterial and fungoid forms which ferment these materials. Under these conditions the sufferer loses flesh and colour, is troubled with thirst and constipation, and his mind is depressed. The abdominal wall bulges over the pit of the stomach, the movements of the stomach are visible to the naked eye, and splashing may be produced. By various means the outline and extent of the dilated organs can be ascertained. **Gastroptosis**, or displacement of the stomach, occurs in some cases, with impaired mobility, gastro-enteric catarrh, and nervous complications; the symptoms which indicate it are malnutrition, gastric fermentation, diminution in the proportion of hydrochloric acid, a sense of dragging or absence of support in the abdomen, and the confirmation of its displacement by inflating or distending the organ with gas.

Treatment.—Simple atonic dilatation gets well if properly treated; obstructive dilatation may be due to causes removable by operation. There is no treatment so beneficial as gastric **lavage**, or washing out the organ; by this means we can remove decomposing food and check the putrid fermentation and consequent generation of gases which expand the weakened organ. By it we can cleanse and soothe the irritated mucous membrane, and assist in strengthening the muscular walls. Lavage consists simply of emptying and washing out the stomach with pure water, natural mineral water, or a solution of one of the disinfectants. It was introduced by *Kussmaul*, who obtained striking results from its use. It gives relief in every case, and where atony or gastric catarrh plays a large part in the process—that is, in simple unobstructive dilatation—this method of treatment, combined with tonics and careful arrangement of the diet, will effectually cure it. The operation may be performed by a stomach pump or by means of a simple indiarubber tube; the latter is most often used, and consists of about 4½ feet of indiarubber tubing, with a funnel attached to one end. In a healthy condition of the stomach 24 inches of tubing is required to reach the lower border of the stomach without doubling, and this may be

increased by several inches in the dilated organ; as much or more tubing should remain outside the mouth as passes through it, otherwise the tube will not act as a siphon, which it is intended to do. The tube is carefully passed over the tongue and between the fauces without touching them; when it reaches the back of the pharynx it will bend, and each push makes it descend further, which is assisted by bending the head slightly on the chest. A little care is required to guide it over the glottis, but when that is passed all fear of entering 'the wrong passage' is over. It must be gently pushed down, because rough usage irritates the gullet. When the tube is in the stomach the funnel should be raised to a level with or above the head, and the lotion poured down it; the funnel is then inverted, and lowered to allow the liquid to run out into a vessel placed to receive it. Stomach tubes having a ball similar to that of a Higginson's enema are very handy. The process of washing out is repeated until the solution comes back colourless from the stomach, and free from food and mucus, after which a pint of liquid is poured in and allowed to remain. Many disinfecting or alkaline lotions are used for this purpose, as well as alkaline waters—*e.g.*, those of Vichy, Carlsbad, Marienbad, Saratoga-Vichy, and Hot Springs. Opinions differ as to the best time of performing lavage; some practitioners urge that it should be performed at bedtime each night, so that the stomach may be freed from all food and given a period of eight or ten hours' complete rest and freedom from irritation; others regard early morning or half an hour before the largest meal as the best time, because washing out the organ at this period cleanses and refreshes the mucous membrane, and prepares it for the work it has to perform. Both opinions have some physiological support, but when lavage is performed only once a day, bedtime is perhaps the most satisfactory period for its performance.

Lavage is *contraindicated* when it causes much distress, nausea, or vomiting: in cases of great debility, recent hæmorrhage from the stomach, cancer of the œsophagus or of the cardiac extremity, or aneurism of the aorta. Usually the first lavage gives such relief to patients that instead of fearing they ask for it; some patients learn to introduce the tube for themselves. After a few washings the stomach often regains the power of pro-

pelling its contents into the bowels, with concurrent relief of constipation and increased flow of urine.

Constipation must in the meantime be corrected by alkaline aperient waters; the best plan is to take a wineglassful every hour of Carlsbad, Friedrichshall, or Condal water, in the morning fasting until it causes an evacuation of the bowels; by this means the stomach also is stimulated and strengthened.

Massage of the abdomen, particularly of the stomach, is useful; it rouses muscular tone and encourages motility, whereby the chyme is passed into the duodenum. Electricity is likewise useful, and has similar effects.

The **food** is exceedingly important. The meals should be few and far apart, highly nutritious, of small bulk, and in some cases in a state of fine subdivision. Starchy and saccharine foods should be restricted or altogether prohibited, to prevent fermentation. The supply of liquids must also be restricted. Hot water should be drunk half an hour before each meal; it cleanses the stomach, prepares it for the reception of the food, and lessens the desire for drinking at meal-times. A single teacupful of weak tea, hot water, milk and water, or a little diluted spirits may be taken during or at the close of the meal; but if any more liquid is required it should be given by rectal injection. There should be only three meals a day: breakfast at 8 a.m., lunch at 2 p.m., and dinner at 8 p.m., allowing six hours between each meal. Many authorities consider it best to take animal and vegetable food separately, one meal consisting of meat, another of carbohydrate and purée of vegetables. The following dietary may be allowed in most cases:

Breakfast.—Fish, as sole, plaice, whiting, haddock, brill, or turbot, with lemon juice; eggs, poached or lightly boiled; thin dry toast, 1 ounce; one teacupful of milk and hot water, or peptonized milk, sipped slowly throughout the meal or at its close.

Luncheon.—Boiled rice, macaroni, sago, or tapioca pudding, about 4 ounces, with fruit, jelly, or cream; purée of fresh vegetables, spinach or vegetable marrow, with gravy. No meat. At the close of the meal 4 ounces of pure water, good red wine diluted with water, or spirit and water.

Dinner.—Tender lean mutton, beef, chicken, or white game,

4 ounces; fish of any light kind; purée of potato, 1 ounce; stale bread or dry toast, 1 ounce; 4 ounces of liquid at the end of the meal, as at lunch.

If this amount of nutriment appears to be insufficient, **nutrient enemata**, consisting of two raw eggs beaten up with a little salt, and 8 or 10 ounces of milk, or similar 'feeds,' may be given twice daily; they are best injected through a long tube passed as high as it will go without doubling, the patient being in the knee-elbow position.

The use of digestive ferments in the treatment must be carefully considered, for it is known that when artificially-prepared foods are taken they are not absorbed without further change. Artificial digestion, whether by means of pepsin and hydrochloric acid or any other method, is quite different from the natural process; and it has been proved by Voit, Cohn, and others, that peptonized preparations when taken into the stomach are not absorbed immediately and without further change, and other observers assert that they cause diarrhœa. Artificial digestion brings about decomposition of substances which are of the highest importance to metabolism.

The patient should be *forbidden* to take butter, sugar, sauces, condiments of all kinds, raw vegetables or fruit, and such cooked vegetables as would produce flatus. As well as the other things forbidden in dyspepsia (*q.v.*), starchy foods should only be eaten in small quantity, and are best taken alone; stale bread or dry toast may be allowed to the extent of 2 ounces a day. Tea, coffee, and cocoa should be prohibited in the early part of the treatment; but when recovery is begun, a small teacupful without sugar may be taken at the end of a meal.

The patient should be warmly clad, and wear a flannel bandage around the abdomen. Kussmaul recommends that a pad should be worn over the pit of the stomach. He should, when in bed, lie upon the right side, to encourage the escape of chyme from the stomach. In some cases it is advisable to keep the patient in bed during the early part of the treatment, so as to prevent wasting of the tissues and to maintain nutritive equilibrium. Alkaline waters, hydrotherapy, electricity, and massage are useful.

Acute Gastric Catarrh.

Normal digestion is attended by a temporary congestion of the mucous lining of the stomach, and an abundant secretion of mucus is a part of the physiological process; this, which is analogous to **catarrh** of other mucous membranes, occurs after every meal, and subsides without trouble and usually without our cognizance. A morbid increase of this condition is, however, liable to occur under many circumstances; the normal rush of blood is then transformed into a condition of inflammation, the mucous membrane becomes swollen and relaxed, and its surface covered with a layer of tough mucus; this constitutes acute gastric catarrh or acute catarrhal gastritis. It occurs readily in debilitated and badly-nourished persons and puny children; a slight error of diet in such persons may cause it. It also arises from a slight excess of drink in persons not accustomed to it, from an excess of food, fat meat, rich gravy, sauces, or highly-seasoned dishes; it is also caused by tainted meat, sour milk, new beer, pickles, spices, ices, cold drinks taken by an overheated person, or catching cold. In many feverish conditions less gastric juice is secreted, and a distressing catarrh may result from a continuance of the ordinary diet or other unsuitable food.

Infants are very liable to gastric catarrh, and only extreme care in feeding can prevent it. I have stated in a former chapter that the milk of the mother or a healthy nurse is by far the most suitable food, but, failing that, good cow's milk is the best substitute; it should be obtained fresh every morning and night as soon as possible after milking, instead of after it has been carted about for several hours, and it is better to boil it (*sterilize it*) as soon as it arrives, and keep it in a covered vessel. The strength of the food must depend on the child's age: for the first three months it should consist of 1 part of *pure* milk and 2 parts of boiled water with a little sugar; from three to six months the mixture should contain equal parts; from six to nine months it may consist of two-thirds of milk and one-third of water, after which age the milk may be given without dilution. The intervals of feeding must necessarily vary with the age of the infant and quantity of the food taken. During the first

week or two only two or three tablespoonfuls can be taken at a meal, and the infant should be fed every hour and a half or two hours; but as more and stronger food is taken the intervals may be gradually increased to three or four hours (see 'Infant Feeding'). Catarrh of the stomach is often caused by errors in diet; the injurious material passes into the bowels, gives rise to colicky pains and flatus, constipation, diarrhœa or lienteric diarrhœa—*i.e.*, passage of undigested food. The carbohydrates of the food are transformed into lactic, acetic, or butyric acids, and carbonic acid gas. The free use of alkalies, lime-water, Vichy water, and lithia water, barley-water, or gum-water, along with the food, neutralizes the acidity, soothes the stomach, and prevents the formation of large or hard curds of milk. But these measures are insufficient in catarrh of the stomach and bowels, when milk is injurious and starch cannot be digested; under such circumstances it is better to refrain from giving either for a little time. Many infants recover when given nothing but a little plain pure water for a day or two; others when given albumin-water, made by whipping the white of an egg and mixing it in 6 ounces of water with a little salt. When the child is recovering, vomiting and purging having ceased, we may commence to feed it by giving small quantities of milk and lime-water or barley-water alternately with the albumin-water, or a little predigested milk, such as Keffir, may be used. If these are rejected, a little diluted meat juice or beef essence may be given in teaspoonful doses; it can be prepared thus: Cut lean meat into small cubes about $\frac{1}{4}$ to $\frac{1}{3}$ inch in size, place them in a bottle without water, close it securely, and boil the bottle for several hours in a pan of water.

In older children and adults it is necessary to enforce rest of the inflamed organ by entirely excluding food from the stomach for a day or two. In severe cases with much pain, tenderness, frequent vomiting, and fever, the patient should be kept in bed, and is usually too ill to get up; should be given bits of ice to suck or ice-water to drink, and be fed by **nutrient enemata**, by which means the vomiting is usually subdued. The alkaline carbonates and carbonic acid gas, in the form of soda-water, Apollinaris water, effervescing powders, Ems, Vichy, or Vals waters, are very useful. The carbonic acid moderates the congestion, soothes the irritated mucous membrane, allays vomiting,

and by causing speedy eructation facilitates the escape of gases which are generated in the stomach; the alkali lessens the toughness of the mucus, assists in its evacuation, and neutralizes the gastric juice. It is sometimes necessary to wash out the stomach with an alkaline water, such as Ems or Vichy, or with ordinary water containing carbonate of soda or boracic acid. The application of ice over the pit of the stomach in the form of an ice-bag or an ice compress (small lumps of ice between layers of flannel) is frequently beneficial; and the opposite method of treatment—that is, by the application of a mustard plaster, mustard and linseed poultice, turpentine, or abstraction of blood by leeches—applied to the same region, will relieve pain, congestion, and vomiting.

In less severe cases, when complete absence of food is not essential, we may give bland and unirritating liquids, such as milk with an equal quantity of lime or barley water, or with about 20 to 30 grains of bicarbonate of potash or soda in each pint; or the alkaline waters of Ems, Vals, Vichy, and many other sources; or gaseous alkaline waters, such as potash, soda, lithia, or Apollinaris waters. Many patients can take arrowroot and milk, isinglass and milk, peptonized milk or gruel, or meat essences; the proper quantity is an ounce of fluid every half an hour, the same amount of farinaceous food every three hours, and meat juice or jelly between the other meals.

When the acute stage has passed off we must keep the patient for some time upon small quantities of very light food, which may be predigested if necessary. We should pass from milk and lime-water, etc., to arrowroot and milk or similar farinaceous foods, peptonized milk gruel, jelly, meat essence, junket, and custard. When the stomach can bear these we may give a little clear soup, milk pudding, boiled bread-and-milk, bread-and-butter, poached egg, light fish, chicken, mashed potato, spinach, vegetable marrow, squash, vegetable purée, and baked apples. There must be a gradual return to the ordinary diet, avoiding those errors which provoked the attack, and especially rich food, entrées, hashed meat, spices, alcohol, etc.

Chronic Gastric Catarrh.

Any cause which produces dyspepsia, indigestion, or recurrent attacks of acute catarrh of the stomach may also cause chronic gastric catarrh or chronic catarrhal gastritis; but it occurs in many other diseases, as obstruction of the portal circulation from disease of the liver, from disease of the heart, lungs, or chronic pleurisy; it usually accompanies organic diseases of the digestive tract, as ulcer or cancer, and blood diseases, such as anæmia.

When this disease has lasted for some time various organic changes take place in the structure of the mucous membrane: patches of reddish-brown or slaty-gray colour occur from hæmorrhages into the mucous lining, and transformation of the colouring matter into pigment; the surface becomes wrinkled and rough from enlargement of the glandular and connective-tissue elements, and a grayish-white mucus adheres to it.

Most patients complain of tenderness at the pit of the stomach on pressure, but pain is not constant nor severe. There are the ordinary signs of functional dyspepsia: fulness and weight after eating, heartburn, water-brash, belching of gas, and sometimes nausea or vomiting. The vomited matters mostly contain mucus, often a good deal of organic acid owing to fermentation, and sometimes fungi and bacteria. There is usually a diminution in the proportion of hydrochloric acid in the gastric juice (hypochlorhydria). In the alcoholic form there is frequently vomiting in the morning of a fluid which consists mostly of mucus and saliva which has been swallowed during the night. Diarrhœa may occur from a concurrent intestinal catarrh, but the bowels are usually constipated, and the urine has a deposit. If the catarrh extends to the mouth, as it often does, the breath is foul; the tongue may be coated, flabby, slimy, and indented on its edges by the teeth; or it may be small, red at the tip and edges; or the gums may be red, spongy, and discharging, and the lips cracked. The general condition is one of **malaise**: the patient is dull, languid, listless, and easily exhausted; mental depression, nervous irritability, headache, and giddiness are common; the heart may be too rapid, intermittent, or irregular. Most of the general symp-

toms are due to imperfect nutrition and auto-intoxication by the products of imperfect digestion.

The course and results of chronic gastric catarrh may extend over months or years, with more or less severity and frequent variations. Most cases of primary catarrh are curable, and a very large number of those of secondary origin disappear with the concurrent disease under careful treatment. When the disease lasts a long time the nutrition suffers, owing to the disturbance of digestion and interference with absorption; in such cases the patient necessarily emaciates, the fat disappears, the muscles become flabby, and the skin dry. A continuance of malnutrition and loss of flesh suggests the necessity of further examination for complicating diseases.

The **treatment** should be begun by forbidding all alcoholic drinks, tea, coffee, tobacco, pickles, and indigestible food; by insisting upon attention to the teeth and gums (obtaining artificial teeth where necessary), slow eating, careful mastication, rest before and after eating; by attention to the skin, regular exercise in the open air, freedom from worry, a calm and tranquil life, with moderate mental or physical work. The choice of food and its careful preparation are equally important. Some kinds of food are easily digested in small quantities, which become a source of pain and irritation when taken in the ordinary amount. Everything depends upon the digestive ability of the stomach and its power of propelling its contents into the intestine; consequently, the food should be adjusted to these conditions. Foods are digestible which are capable of chymification without burdening the stomach, which are emptied into the intestine in proper time, and do not unduly tax the functions of the latter. There are many degrees of chronic gastric catarrh, from a slight diminution of the digestive function to absolute loss of secretion or atrophy of the secreting glands; and cases may be classified as catarrh with (*a*) diminution of hydrochloric acid, (*b*) absence of hydrochloric acid, (*c*) absence of gastric ferments or atrophic gastritis. These conditions are ascertained by an examination of the contents of the stomach after a test-meal. The patient has for breakfast a dry roll and a glassful of warm water, and an hour afterwards the contents of the stomach are removed by a tube and examined chemically and microscopically. If hydro-

chloric acid be present in the proportion of 0·2 per cent., gastric catarrh or gastritis is excluded; it is usually deficient, and may be absent entirely. Besides searching for free hydrochloric acid, the presence of pepsin and rennin ferments are ascertained; if they are absent, we are dealing with a case of atrophic gastritis. The presence of mucus in increased amount is a decided indication of gastric catarrh.

The food requires very careful consideration. When the stomach is unable to digest proteids, owing to the deficiency of gastric juice or of its ferments and acid, the digestion of carbohydrates may be perfect. Proteid should then be given in a prepared or semi-digested form, as albumin, peptone, and casein preparations. In these cases fat is likewise digested with difficulty, or is split up into fatty acids in the duodenum, and so does not enter the lymph channels in the usual way as neutral fat; but the free use of sodium chloride or salt is useful by helping to form hydrochloric acid and assisting to check fermentative processes. No stereotyped diet list will suit every case—each one requires careful consideration, but certain general rules are applicable to all.

The patient must *avoid* very hot or very cold drink and ices; fat meat, sauces, rich food, pork, veal, game, sausage, duck, goose; heavy kinds of fish, such as mackerel, salmon, and eel; new bread, hot buttered toast, crumpets, muffins, pastry; shell-fish; cheese; heavy vegetables, such as carrots, turnips, parsnips, cabbage, dried peas, and beans; the cellulose coverings of fruit, and fruit containing seeds, such as currants, gooseberries, figs, etc.

Though the power of the gastric juice to digest proteid substances is diminished in chronic gastric catarrh, the patient does better with a moderate amount of carefully-selected fish, fowl, or meat, than if they are entirely excluded and only farinaceous foods allowed.

Allow: In mild cases no limitation of the amount of food is necessary, providing it be of the right character and properly masticated; for when the muscular power of the stomach is good, any food which is not digested in the stomach will be propelled into the intestines and digested there. It is better, therefore, for the patient not to reject all proteid, or all carbohydrate or fat, but to take a judicious mixture of them, selected from such lists as that given under 'Indigestion.'

In severe cases, begin with milk and farinaceous foods—*e.g.*, milk puddings or fine oatmeal—then cautiously add light fish, poached eggs, scraped meat, chicken panada, bread-and-butter; then mashed potato or yam, purée of vegetable, spinach, vegetable marrow, squash, cauliflowers; finally beef, mutton, fowl, or pheasant.

In all *ordinary cases*, clear soups, thick soups, consommé, vegetable purée, jelly, meat powder, scraped meat, chicken panada, soft-boiled eggs, tender lean meat, chicken, or pheasant will be usually readily absorbed; and as a rule, any food which has been passed through a fine sieve may be permitted. The supply of carbohydrate should not be restricted; starch is usually well digested, providing the bread, etc., is well masticated and the saliva is active; but some authorities do not allow such carbohydrates as arrowroot, cornflour, or starch and oatmeal, which are swallowed without mastication and do not mingle with the saliva, because they are apt to ferment in the stomach and produce acidity and flatulence. Fat is allowed in the form of cream and butter, but an *excess of butter* will check gastric secretion. Spices and condiments in moderate amount are useful by stimulating the secretion of the digestive fluids and producing carminative and aromatic effects. The meals should be small, concentrated, and plenty of time allowed for digestion.

In the **atrophic** form of the disease, where the ferments are deficient or absent, an absolute milk diet is sometimes necessary; but this may usually be supplemented by meat powders, milk powders, and peptonized gruel, or other predigested foods; a minimum of food necessary for nutrition is for some time the only useful treatment.

Patients with gastric catarrh must avoid strong tea, coffee, and all kinds of alcohol. The drink should consist of a tumblerful of warm alkaline water taken half an hour before each meal, such as the natural mineral waters of Vichy, Ems, Bilin, Selters, Salzbrun, or Saratoga-Vichy; or those of Bath, Marienbad, Carlsbad, or Hot Springs, which contain chloride of sodium. These waters may be taken at home or at the spa. Their use is to cleanse the mucous membrane, remove tenacious mucus, neutralize organic acidity, rouse the circulatory activity of the gastric mucous membrane, and stimulate the secretion of gastric

juice and muscular activity of the organ; they likewise lessen the desire to drink during the meal, and thereby permit the salivary and gastric secretions to act without dilution. The patient should never drink during the meal; but at the end of it or an hour or so afterwards he may have a small teacupful of China tea, thin cocoa, pure water, Apollinaris, Salutaris, or other gaseous water, and whey or buttermilk. A little red wine, such as Bordeaux, Burgundy, or Hungarian, diluted with a gaseous or alkaline water, may be taken in mild cases, but it is better to forbid alcohol in most instances.

Constipation must be treated. The aperient waters of Carlsbad, Friedrichshall, Hunyadi Janos, Pullna, or Condal, are valuable in instances where the disease has been caused by excess of alcohol, by chronic congestion of the liver, or failure of the circulatory system. The mild waters are to be preferred when they are sufficient to effect an evacuation, but the strong ones may be used according to necessity. They remove fluids from the body, relieve the congested veins, cleanse the system by removing the products of imperfect digestion, and stimulate the general circulation and metabolism.

Lavage, or washing out the stomach, is an important part of the treatment of all bad cases; lotions consisting of plain warm water, hot water containing a small amount of sodium bicarbonate or chloride, boracic acid or lime-water, or the natural water of Hot Springs, Vichy, Ems, Bath, Malvern, and other places, may be used. If the patient refuse lavage, it may be useful to administer an emetic to him occasionally. Enemata of a pint of these liquids daily are useful in assisting to restore the motor activity of the stomach.

Moderate physical exercise is necessary in all cases, and light massage and hydrotherapy may be useful.

The Effect of Spices in Diseases of the Stomach.—Experiments carried out by Korczynski tend to prove that spices assist the motor functions of the stomach; but they progressively impair the secretory function and finally inhibit the production of hydrochloric acid; on the whole they tend to hinder rather than help digestion. They are useful to persons in whom the digestion is slow, owing to deficiency of muscular power, and in those with hyperchlorhydria. Such substances may also tend to

check fermentation, and are of decided value for dispelling flatus, stimulating the circulation through the organ, and thereby assisting absorption. A similar influence is exercised by menthol, which is the active principle of peppermint, and allied to some of the spices. Vladimirsky has shown by experiment that it diminishes the amount of *free* hydrochloric acid; that the digestive power of the gastric juice is thereby diminished, and the transformation of proteid hindered by it; that the motor power of the stomach is checked; that lactic acid rises in proportion as hydrochloric acid is diminished; but the absorptive power of the stomach is increased by stimulation of the circulation.[11]

Ulcer of the Stomach.

The cause of this trouble is obscure, but it occurs most commonly in females from eighteen to twenty-five years of age, and occasionally in children and old men; it is usually preceded and accompanied by debility, anæmia, or chlorosis, while gastric catarrh and constipation are nearly always present, and bring in their train the symptoms characteristic of each. The special signs indicative of an ulcer are pain, vomiting, and hæmorrhage.

The pain of an ulcer may be circumscribed to one spot or diffused over the pit of the stomach. At the first commencement of the trouble there is a slight disturbance of the digestion and oppression after food, or discomfort when anything is tight around the waist. In these early cases a diagnosis of ulcer is not possible, but later there is a steady pain in the pit of the stomach, increased by pressure at a circumscribed spot; sometimes there are paroxysms of pain after eating, starting from the pit of the stomach and extending towards the back or between the shoulder-blades, especially after hot, pungent, or indigestible foods. The pain lasts as long as there is food in the stomach, and when very severe it causes the patient to sigh or groan, and no relief is obtained until the stomach is emptied by vomiting, or the food is chymified and passed into the intestine, which may require hours. It is due to the movements of the stomach, or the gastric juice, whose secretion is excited by the presence of food, irritates the ulcer and causes pain, for in the intermissions there is no gastric juice and the ulcer is covered by mucus. In

some obscure cases pain is absent, so that perforation of the stomach or severe hæmorrhage may happen unexpectedly, the only previous trouble being merely a little dyspepsia or uneasiness after food.

Vomiting is almost a constant symptom, and it occurs sooner or later after a meal, according to the position of the ulcer. Vomiting is rarely absent; it is exhausting *per se*, as well as by the removal of food and prevention of nutrition. Coarse kinds of food, as bread, potatoes, and vegetables, excite more energetic movements of the stomach, accompanied by severe pain and vomiting, than soup, milk, and other soft or fluid articles of diet. The vomited food is usually more or less changed in proportion to the time it has remained in the stomach; it is often mixed with mucus, owing to a concurrent gastric catarrh, and may be sour from the presence of butyric, acetic, and lactic acids, or fungi. Severe pain and vomiting occurring regularly after meals make it very probable that a chronic ulcer of the stomach exists, and this is rendered certain by vomiting of blood. Hæmorrhage of necessity varies in amount from a little oozing from the surface or edges of the ulcer to a large gush of blood, caused by the bursting of a bloodvessel. The vomited blood may be of a dirty brown colour, from the action of gastric juice upon it; profuse vomiting of bright-coloured blood is indicative of erosion or 'bursting of a bloodvessel,' the blood being vomited before the gastric juice has time to alter its character. Blood may pass through the bowels and cause 'tarry stools.' Bleeding may occur frequently during the existence of an ulcer, because the movements of the stomach tend to reopen the vessels.

Chronic catarrh of the mouth frequently complicates gastric ulcer, but instead of the tongue being thickly coated, it is usually red and furrowed. In many cases there is soreness of and discharge from the gums, and the fluids from the mouth, which are swallowed during the night, irritate the stomach, almost certainly increase the vomiting, and may set up blood-poisoning. The general health suffers from an ulcer of the stomach, owing to pain and impairment of nutrition; the patient becomes pale, anæmic, and languid. Perforation of the stomach occurs in 6·5 per cent. of the cases; in chronic ulcer it is always caused by distension with food or gas, retching, vomiting, coughing,

straining, or some other effort. Peritonitis may follow, with fatal results in a day or two unless an operation is performed to close the wound. Hæmorrhage from rupture of a large vessel may cause death very speedily, but repeated hæmorrhages occur in some cases without any untoward consequences. The prognosis is on the whole favourable to recovery, but the disease may alternate, relapses occurring until the ulcer is quite healed over.

Treatment.—The patient should be put to bed for fourteen to twenty-one days to remove all sources of irritation, to secure the greatest amount of comfort to the body and rest to the organ, and to reduce the wants of the system to the lowest terms. The necessity for absolute physiological rest is recognised as an important element of the treatment by all authorities, but it is not always enforced in mild cases, with the consequence that relapses are frequent.

In mild cases of repeated vomiting and pain after food an exclusive milk diet, or such foods as will not irritate the ulcer mechanically or chemically, may be allowed. Give at first 2 ounces of milk every two hours (a pint a day); the amount must be small. If it is not well borne, it must be diluted with as much lime-water, soda or other alkaline water, or it may be peptonized. We may also allow an egg once a day; let it be beaten up, mixed with 2 ounces of milk and water and a little sugar. Stale milk roll may also be allowed two or three times a day, prepared as follows: Soak 1 ounce of breadcrumbs in boiling water, strain the water away, rub it through a sieve, and mix with it 3 ounces of milk and water.[12] We may also allow a cupful of weak tea (nearly all milk), or tea made with boiling milk instead of water. We must gradually increase the consumption of milk, as we find the stomach can bear it, until 4 or 5 pints are taken in twenty-four hours. About the third week of treatment we may thicken some of the milk with biscuit powder, arrowroot, fine oatmeal, or one of the patent invalid foods; we may also give peptonized milk gruel, jelly, custard, junket, powdered or scraped meat. After another week or ten days, if the symptoms have subsided, an experiment may be tried with light fish or chicken, and, if these are borne with comfort, gradually return to the ordinary diet, taking care to avoid anything which may unduly tax the stomach or cause indigestion.[13]

Professor Saundby[14] allows from the commencement of the treatment 1 ounce of milk and 1 ounce of lime-water every hour, and increases it to 2, 3, and 4 ounces on successive days. He then allows soft bread, custard, mashed potato, minced chicken, or fish, and gradually increases the amount and solidity of the food, until ordinary food is reached in the third week. This, however, is a very rapid progress, and is very liable to be followed by a relapse.

In severe cases, with pain, vomiting, and hæmorrhage, most authorities allow nothing by the mouth for about ten days. The patient is fed by the bowel alone, with 'feeds' similar to the following—great care is necessary in this important part of the treatment: (*a*) Beef-tea, 5 ounces; peptonizing powder, $\frac{1}{2}$ tube; glucose, a dessertspoonful; brandy, ditto; and a little common salt. (*b*) One raw egg beaten up, 4 ounces of milk, a little salt to assist its absorption. (*c*) Peptonized milk, 5 ounces, or similar substances. Each meal should only consist of 5 or 6 ounces, administered through a tube with a glass nozzle, the patient meanwhile lying upon the side or in the knee-elbow position. A funnel attached to the tube is held about 2 feet above the patient's hips, and the food poured into it, and allowed to enter the bowel by its own weight. Ewart[15] prescribes continuous rectal alimentation as follows: A length of tube is used, to one end of which is fitted an indiarubber male catheter, and to the other the body of a 5-ounce glass syringe. The catheter is inserted into the rectum as far as it will go without doubling, and allowed to remain in all day; the glass container is fixed about 2 feet above the patient's hips; a clip is put upon the tube to regulate the flow, so that 5 ounces of fluid pass into the bowels in about two hours. He gives the following mixture: To 1 pint of milk add two raw eggs, beaten up, two teaspoonfuls of extract of malt, and a little brandy.

The idea of rectal feeding is to give the patient enough nutriment to supply the waste of the tissues, and a little more to help in the healing process. But a careful analysis by Edsall and Miller[16] of the enemata, urine, and fæces of patients fed exclusively by the bowel in gastric ulcer shows that only in exceptional cases does rectal feeding provide enough nutriment to prevent tissue loss, and even then the patient remains in a

condition of decided subnutrition. Boyd[17] asserts that only 210 calories a day can be obtained by rectal feeding, which is a small amount compared with the 2,300 calories required by the body. Griffiths mentions two guides as to the adequacy of the nutrition afforded: When the patient is amply and well fed, the tongue is moist and clean and the breath sweet (normal); but when a patient is starving or the nutrition very inadequate, the breath is tainted or offensive, there is a great thirst and a dry tongue. Several writers question the necessity for nutrient enemata during the ten days when nothing is given by the mouth; they say nutrient enemata satisfy the mind rather than the body. Feeding by the rectum is decidedly better than starvation, however inadequate it may be. About a tenth of the nutriment necessary to maintain a physiological balance can be absorbed in this way, but Miller and Edsall assert that in exceptional cases the nutritive equilibrium is fully maintained. Experience proves that rectal feeding can only be safely continued in most cases for eight or ten days; the absorption of nutriment is too scanty for longer continuance, and the risks of semi-starvation are as great as those of stomach-feeding.

Besides giving nutrient enemata, *water*, which is usually readily absorbed, must be injected into the bowels to supply the physiological needs of the body and quench the thirst. Injections of 10 to 20 ounces of plain boiled water or normal saline solution at a temperature of 97° to 100° F. may be given every four or six hours; starvation is well borne when plenty of water containing a little salt is injected. When rectal feeding is properly performed the patient is usually free from pain, hunger, vomiting, and thirst after a few days' treatment.

Troubles sometimes arise during rectal feeding. The rectum is irritable from the commencement with some people, in others it becomes very intolerant of the enemata after a little time; it is advisable, therefore, to wash it out once a day with a mild antiseptic lotion, such as boracic, to check putrefaction and subdue irritability of the bowels. Mumps is also liable to occur, and requires the ordinary treatment for that complaint.

The question has to be considered whether we may allow any fluid by the mouth during the period of rectal feeding. Some authorities allow ice to suck, iced water, hot water, Vichy and

other alkaline waters, to quench the thirst and subdue vomiting. King[18] also allows a teaspoonful of water every fifteen minutes, or 15 ounces in twenty-four hours, which he asserts is too small a quantity to do any harm, although larger amounts set up peristaltic action. But if we are to act on the principle of giving absolute physiological rest to the stomach even this must be forbidden, and nothing except medicine allowed through the mouth, for every movement delays the healing process.

Vomiting usually ceases when physiological rest of the stomach and body is enforced, but patients who are prone to vomit must be kept scrupulously still, even avoiding shaking the bed or turning over. Vomiting is sometimes maintained reflexly by the rectal injections, and it has been asserted that the salt, given with raw eggs or in normal saline solution, keeps it going. The state of the mouth, especially when the gums are ulcerated and pus and microbes are swallowed, causes vomiting; a mouth wash should then be used several times a day and the teeth cleaned. The application of a mustard plaster, iodine, or turpentine to the pit of the stomach may check vomiting; in rare cases it only ceases when the rectal feeding is omitted, then we must give peptonized milk or milk gruel and meat juice or essence by the stomach.

If an attack of bleeding (**hæmatemesis**) occurs, ice-bags should be applied over the stomach for an hour or two, then removed for the same period and applied again. It should not be forgotten, however, that the application of ice to the stomach may increase the condition of collapse or prostration by abstraction of heat; but the application of a mustard plaster to the soles of the feet or injections of saline solutions under the skin or into the rectum will help to restore the patient. An operation may be required if it is suspected that the bleeding is taking place from a large bloodvessel.

After ten days of rectal feeding we may begin to give the patient small quantities of milk and water by the mouth, and if it neither causes pain nor vomiting it may be continued. But the rectal injections should be kept up for a few days longer, and gradually diminished as more nutriment is taken by the mouth, and the dietary given above for a mild case is being used.

Spa Treatment.—In mild cases of ulcer and in the chronic

ulcers of old men, when gastric catarrh is a well-marked feature of the case, spa treatment is sometimes recommended. The thermal waters of Carlsbad, Marienbad, Wildbad, Tarasp, and other places, which contain alkaline carbonates and sulphates, are the most suitable. The carbonate of soda in them dissolves the tenacious mucus, detaches it from the mucous membrane, and acts as an antacid; the chloride of soda is antiseptic and a stimulant to digestion; and the sulphate of soda stimulates peristaltic action, and promotes expulsion of the gastric contents into the intestine. The water must be drunk warm (100° to 120° F.), and taken when the stomach is empty; four wine-glassfuls or tumblerfuls should be taken at intervals of fifteen minutes before breakfast. No food should be taken until half an hour after the last draught of water. Two or three motions should occur after breakfast, and more or less water should be taken in proportion to these evacuations. Lavage of the stomach with the spa water is also recommended for chronic gastric ulcer in old men.

The after-treatment of a case of gastric ulcer is important; a careful regimen must be enforced, including careful feeding, and the correction of constipation, dyspepsia, anæmia or chlorosis.

Cancer of the Stomach.

Cancer more frequently attacks one of the apertures than the body of the organ, and in its treatment it is necessary to distinguish the site of the growth. There is always vomiting or regurgitation of food. When the cancer is in the body of the stomach it only occurs now and then, but if at one of the orifices it occurs at each meal. (*a*) When cancer affects the cardiac orifice or implicates the gullet, the vomiting occurs during or immediately after each meal. The food does not always enter the stomach, but remains in a pouch or dilatation of the gullet, when vomiting and regurgitation necessarily occurs. Food brought up from the gullet is alkaline, but is otherwise unaltered, except for the presence of mucus; food from the stomach is acid. A bougie or œsophageal tube passes through the gullet with difficulty; the abdomen is flat, the pit of the stomach sunken, and the ribs prominent; the stomach contracts or atrophies.

(*b*) Cancer at the pyloric end of the stomach forms an obstruction to the passage of food into the bowels. Vomiting does not occur in these cases until several hours after food is taken; it is then very copious, and the material vomited is sour or foul from the presence of lactic, butyric, and acetic acids, and microscopical examination reveals the presence of bacteria and fungi. The stomach is dilated, whence the pit of the stomach is prominent. A tumour may sometimes be felt, and there may be hæmorrhage from the breaking down of the cancerous mass; but copious bleeding would favour the probability of the disease being an ulcer rather than a cancer. The general symptoms are those of chronic gastric catarrh or ulcer, or of dilatation of the stomach when the growth is in the pylorus. Dyspepsia, vomiting, ejection of sour fermented or putrefied material, sour eructations, tenderness in the pit of the stomach, vomiting of blood, blood in the motions, constipation, and progressive loss of flesh, are among the chief symptoms; they all occur in other diseases, but if there is added to them the signs of cachexia, a dirty yellow, earthy, or fawn colour of the skin, if enlarged glands or a growth can be felt, the existence of cancer can scarcely be doubted.

The **diet** must be arranged in all cases to supply the demands of the body and check emaciation. (*a*) When the cancer affects the cardiac orifice and the gullet, the food should consist of milk, beef-tea, raw eggs, meat essences, potato purée, consommé, fine oatmeal, arrowroot, and other farinaceous foods, in sufficient quantity to maintain the requirements of the body. Four pints of milk, 2 ounces of fine oatmeal or cornmeal, 2 ounces of arrowroot, $\frac{3}{4}$ ounce of sugar, $\frac{1}{2}$ ounce of butter or other fat, form a dietary which will yield 2,217 calories. This is a little short of the amount required for a man doing ordinary work, and contains nearly the normal amount of proteid, carbohydrate, and fat required daily according to Ranke. The patient should be fed three times a day by means of a tube, $1\frac{1}{2}$ pints of thickened milk or milk and raw eggs being poured in at each meal. So long as it is possible to pass even a small tube the patient should be fed in this manner; when it becomes impossible, rectal feeding must be resorted to. Sometimes, after intermitting gastric feeding for a few days, a tube can be again passed through the gullet into the stomach and the patient fed as before. When, however, the

tube can no longer be passed through, the question of an operation to permit of his being fed through the abdominal wall has to be considered; this may be the means of lengthening life for a short time, but that is the utmost that can be hoped for at present when the diagnosis of cancer is undoubted.

(*b*) When the cancer is at the pyloric extremity, and thereby obstructs the passage from the stomach into the bowels, such food as bread, potatoes, sweet potatoes, arrowroot, cornflour, oatmeal, biscuit, rusk, and all other farinaceous foods, *must be forbidden*, because they cannot be digested in the stomach, and their passage into the bowels is hindered by the growth. If these foods be consumed, they will ferment and cause much flatulence and acidity, with increase of pain, fulness, belching, regurgitation, or vomiting. The proper food is plainly one which contains the most proteid and least carbohydrate. For this reason milk is decidedly the best, if it can be borne; it may be peptonized or diluted with Ems, Vichy, or lime water. We may add to the list raw eggs, concentrated broths, scraped meat, soft fish, chicken, oysters, meat extracts, meat powders, or milk powders. All solid food should be finely minced and passed through a sieve to remove all particles of fibrous, stringy, and cartilaginous substance or other indigestible residue. Ordinary cooked meat contains 27 per cent. of proteid, of which only 17 are digestible, therefore the residue must be removed in the manner stated. Chicken and fish also contain about 17 per cent. of digestible proteid; the fat in fish and chicken is about 3 per cent., in cooked meat 15. A dietary consisting of 4 pints of milk, two raw eggs, and 8 ounces of meat, fish, or chicken, will yield 146 grammes of available proteid, 108 of carbohydrate, and 105 of fat, with 2,490 available calories or units of heat and energy. More proteid is here allowed than in the normal diet, to make up for a deficiency in carbohydrate; the nitrogenous excretion has therefore to be carefully watched by an estimation of the urea output every few days. About half the proteid may be converted into fat, and yield heat and energy.

In hæmorrhagic cases the patient should be fed by the bowels only during and for a few days after the cessation of bleeding, and in non-bleeding cases it is also advisable to give the stomach a few days' entire rest while rectal feeding is carried out. Rectal

foods, such as those named for ulcer of the stomach, as peptonized milk, peptones, beef-tea, egg-and-milk, with salt, alcohol, and plenty of plain water, are advised. Beaumetz prescribed the following rectal meal: The yolk of an egg, $\frac{1}{4}$ pint of milk, 1 ounce of liquid peptones, 5 drops of laudanum, 8 grains bicarbonate of soda, 15 grains of common salt; mix. The carbonate of soda and salt render the liquid alkaline and assist in its absorption, and opium checks the irritability of the mucous membrane. Egg-albumin and milk, peptonized or not, are absorbed by the mucous membrane and assimilated; 15 grains of salt to each egg or $\frac{1}{4}$ pint of milk should be added according to some authorities, but Ewald believes peptonization is better. Hubers'[19] method of preparation is as follows: Six eggs and 90 grains of salt are mixed together, $3\frac{1}{2}$ ounces of a 0·15 per cent. solution of hydrochloric acid containing 75 grains of pepsin are added to it, and the mixture is kept for ten hours in a warm chamber. Boas[20] recommends $\frac{1}{4}$ pint of milk, the same of wine, the yolk of two eggs, a little salt, and a teaspoonful of peptone; beat these together and mix well; a little grape-sugar may be added. Such enemata are useful, not only in cancer of the stomach, but in some cases of gastric dilatation, gastric neuroses, gastric ulcer, the vomiting of pregnancy, and after abdominal operations, their value having been established by Voit, Bauer, and other dietetic specialists. But it is doubtful how much nutriment can be absorbed *per rectum*, probably not more than will yield 210 calories, or one-tenth of the bodily requirements; nevertheless, this is better than starvation, for peptones, salt, alcohol, and water are absorbed, thirst is assuaged, the body stimulated, and the mind relieved of the idea of starvation. The rectum should be washed out once a day with a mild antiseptic lotion. *Normal saline solution* may be injected in quantities of 15 to 20 ounces two or three times a day, to quench thirst and prevent the drying up of the tissues. The *New York Medical Journal* gives the following formula for it: Chloride of lime, $3\frac{3}{4}$ grains; chloride of potash, $1\frac{1}{2}$ grains; chloride of soda, $2\frac{1}{2}$ drachms; distilled water 2 pints; mix. This solution is also injected into the veins or the areolar tissue of the armpit and elsewhere when a patient is exhausted or collapsed from loss of blood.

The general treatment of cancer of the stomach consists in

relieving pain, acidity, vomiting, fermentation, flatulence, and constipation. Pain and vomiting are often due to acidity and distension, from the production of gas and organic acids. The administration of charcoal in biscuits or powder, and various antiseptic or disinfecting powders, may be given to check fermentation, putrefaction, and flatulence. Flatulence may also be relieved by a judicious mixture of cloves, nutmeg, ginger, cinnamon, or fennel with the food. Lavage of the stomach in pyloric cases likewise aids in removing the micro-organisms which are so largely responsible for the decomposition of food, generation of acids and gas, and increase of dilatation. Constipation should be relieved by enemata or by saline aperient waters. Persistent vomiting, sometimes caused reflexly by irritation of the rectal mucous membrane, will be relieved by washing out the rectum with a soothing lotion, or by the application of ice, ice-bag, or mustard plaster to the pit of the stomach. Various operations may be considered, such as resection of the pylorus for relief of pyloric cancer, gastro-duodenal anastomosis, or making a fistulous opening through the abdominal wall for the purpose of feeding a patient.

References: [1] Osler's 'Medicine.' [2] Taylor's 'Practice of Medicine.' [3] Max Einhorn, *American Medicine*, June 21, 1902. [4] Knapp, *Medical Record*, September, 6, 1902. [5] Boas, *Deutsch. Med. Zeit.*, 1890, 43. [6] Grierson, 'Year-book of Pharmacy,' 1894, 354. [7] Max Einhorn, *loc. cit.* [8] *Brit. Med. Jour.*, 1904, i., 22; [9] G. See, *Semaine Médicale* (*Brit. Med. Jour.*, October 4, 1890). [10] Matthieu, *Rev. de Thérapie*, 1895, 8. [11] G. Sée, *loc. cit.* [12] Yeo's 'Handbook of Medical Treatment.' [13] *Brit. Med. Jour.*, 1903, vol. ii. (Report of the Meeting of the British Medical Association, 1903). [14] *Ibid.* [15] *Ibid.* [16] *ibid.* [17] *Ibid.* [18] *Ibid.* [19] Singer, *Centralb. für ges-Therapie*, March, 1905. [20] Boas, *Ibid.*; and the following: Brunton's 'Disorders of Digestion'; Bruce's 'Materia Medica and Therapeutics'; Bristowe's 'Medicine'; Niemeyer's 'Medicine'; Coat's 'Pathology.'

CHAPTER XXII

DISEASES OF THE INTESTINAL CANAL

CONSTIPATION.*

Constipation is one of the most common diseases of the intestines; it may be a primary or secondary affection. It should be regarded as a *symptom* in every case; unless we do so we shall

* The chief portion of this section was written by the author for the *Medical Brief*, November, 1904, from which it is extracted.

be unlikely to effect a permanent cure, for the cause will probably continue to exist. Suffering from constipation is a relative term; although one daily evacuation of the bowels may be regarded as normal, some persons only feel well when they have two or three movements a day, others feel well who are only moved every second or third day, and do not feel so well if they are moved oftener. The latter probably eat but little food, and that of a character which leaves very little residue when well digested; the former eats more food of a character which is not so easily digested or leaves a larger residue. But persons eating the same food and in similar proportion likewise show a difference in the number or frequency of their evacuations. This is due to the fact that in one individual the mucous membrane is not irritated by the presence of fæces; there is a sluggish movement, probably very little fermentation or generation of gas takes place, and there is no feeling of discomfort. In the other individual the mucous membrane is more sensitive to the presence of fæces, muscular action is more easily provoked and more vigorous, decomposition is more rapid, quantities of gas are generated which cause discomfort and readily provoke an evacuation of the bowels.

The retention of fæces (constipation) in the lower part of the intestines, such as the flexures of the colon or rectum, produces great discomfort or actual pain in the abdomen, and puts the patient in a disagreeable frame of mind; it produces malaise, headache, languor, and unfitness for the duties and pleasures of life; the tongue becomes coated, there is a bad taste in the mouth, sometimes offensive breath and other unpleasant symptoms, which are more or less due to auto-intoxication by absorption of material from the lower intestinal tract and deleterious effects upon the nervous system. The results of chronic constipation are very numerous, and sometimes serious: chronic intestinal catarrh, mucous and membranous colitis, gastro-enteric catarrh, and other diseases of the alimentary and nervous systems, follow its neglect. Pressure of the full intestine upon neighbouring organs, bloodvessels, and nerves is very injurious; uterine displacements are caused or aggravated by it; fissures of the anus result from overdistension, and end in prolonged ill-health. Pressure on the veins by a distended bowel causes coldness of the feet, because it obstructs the circulation (an ex-

ceedingly common complaint), and leads to hæmorrhoids, uterine catarrh, and excessive discharges in women, and seminal emissions in men. Similar pressure upon nerves causes discomfort about the generative and other organs in the lower parts of the bowels, neuralgia, sciatica, or numbness in the buttocks and thighs.

Constipation is more frequent in women than men. It often arises in childhood or about puberty as the result of atony of the intestines, but more frequently from the bad habit of neglecting the 'call of Nature,' of restraining the fæces through mock modesty. People who lead a luxurious life are often the victims of constipation through want of exercise and sedentary habits; it also arises through frequent pregnancies and inactivity of the abdominal muscles. It occurs in such diseases as anæmia and chlorosis, or from the abuse of aperients and drug-taking generally. Organic disease of the bowels, cancer, stricture, bands and adhesions, are notable causes of some cases. Chronic intestinal catarrh produces a subparalytic state of the bowel, with consequent constipation.

Nothnagel divides the causes of constipation into three groups: (1) Those dependent upon some physiological factor, as deficiency of fluid, improper food, irregular habits, errors in dress. (2) Those due to pathological causes, such as catarrhal enteritis, cancer, and stricture. (3) Those in which constipation is the chief symptom, but is dependent upon atony of the muscles of the intestines, lack of secretion by the intestinal glands or liver, and insufficient stimulation by the presence of fæces. The influence of the nervous system upon intestinal action is well known. The nervous supply of the bowels is very complex, both the spinal and sympathetic nerves contributing to the arrangement; their action in producing diarrhœa and constipation is frequently observed. Although not very clearly understood, enough is known to assure us that the functional integrity of the nervous system is essential if we are to cure either diarrhœa or constipation, which is of long duration.

The importance of discovering the cause of constipation is obvious when we consider the wide range of diseases in which it is a symptom; it is necessary, therefore, to avail ourselves of a physical examination for hæmorrhoids, fissure or ulcer of the anus, stricture, cancer, uterine displacements, or tumours. The

observation of the fæces may assist in arriving at a conclusion as to what is the cause. In ordinary constipation the fæces are usually sausage-shaped and of a moderate size, but thin, pencil-shaped fæces indicate a contraction of a length of gut, small round masses, like sheep's dung, a ringlike constriction, and riband-like masses are due to pressure causing a narrowing of the passage by a growth implicating or pressing upon one side of it. Gastro-intestinal catarrh, mucous colitis, ulcer of the stomach, anæmia, chlorosis, neurasthenia, and other diseases of which constipation is a symptom, should be looked for and treated.

During the treatment of constipation, improper food, insufficient liquids, irregular habits, and bad dressing on the part of women, must be corrected. Drastic purgatives are worse than useless in most cases; enemata, especially of oil, are better, and they should only be used as adjuvants to other treatment.

The **diet** is very important, for it is often found that the patient eats and drinks what she should not, and does not eat and drink what she ought. In the first place, then, we must give a list of *forbidden* articles, which include milk, arrowroot, cornflour, sago, tapioca, rice, excepting a very small quantity of milk pudding; eggs should be forbidden, except ' scrambled eggs ' occasionally, because they are constipating; also cheese, peas, broad beans, haricot beans, new potatoes, pineapple, nuts; smoked, salted, or potted meat or fish; pork, liver, veal; spirits and red wine.

In choosing a diet we must consider the patient's idiosyncrasies; it should always be a mixed diet, and sometimes a change from one kind of food to another will effect a cure. The principle should be that of giving a large amount of vegetable matter, and in some cases almost a vegetarian diet, which as a rule is coarser than animal food and starchy materials, and contains a much larger amount of residue, which by its presence stimulates intestinal activity. In all ordinary cases we may *allow* clear soup made of any kind of meat, fish, game, poultry, *fat* ham or bacon, all kinds of butcher's meat (excepting those named above); **oat-cake, rye-bread**, white, brown, or wholemeal bread, but never new; currant cakes, ginger-bread, ginger-nuts, parkin, oatmeal, hominy, or corn-mush; also cooked vegetables, such as cabbage, savoy, kale, brussels-sprouts, broccoli, cauliflower, spinach,

potatoes, sweet potatoes, yam, asparagus, green peas or beans, boiled onions, or celery. Salads *mixed with oil*, such as lettuce, watercress, endive, tomato, onion, celery, cucumber, beetroot, sorrel, dandelion, and other green vegetables which leave a large residue. Dessert may consist of plain pudding, boiled suet pudding, Yorkshire pudding, fig pudding, stewed prunes, rhubarb, figs, apricots or pears ; apple-charlotte, baked apples with cream, Normandy pippins ; preserved fruit, jam, marmalade, and honey or treacle, should be eaten freely, with bread-and-butter or plain puddings. Raw fruit may also be taken abundantly, as figs, prunes, dates, grapes, raisins, currants, oranges, bananas, melons, water-melons, apples, pears, strawberries, gooseberries, currants, plums, damsons, and peaches. The 'grape cure' is suitable for constipation.

Drink may consist of pure cold or hot water taken at bedtime, before breakfast, and with other meals. Coffee, thin cocoa, tea, butter-milk, whey, koumiss, new cider, new beer, bitter beer, porter, orange juice, grape juice, linseed tea, lemonade, and alkaline waters, such as Vals, Vichy, Carlsbad, Kissingen, Kronenquelle, St. Galmier, Saratoga-Vichy, and Hot Springs, Arkansas. As a general rule, constipated people do not take enough to drink. An adult must consume 4 pints of water daily to supply the physiological requirements of the animal economy. Let it be granted that 1 or $1\frac{1}{2}$ pints is consumed in the food we eat, then $2\frac{1}{2}$ or 3 pints ought to be drunk in various forms during the day. A close inquiry will often reveal the fact that a constipated person drinks practically nothing, half a cup of tea morning and afternoon and a glass of wine for dinner representing all that is taken. This is a sufficient cause of constipation in many people, and its natural cure is to imbibe more freely. Let the person drink a tumblerful of hot or cold water while dressing in the morning, a large cupful of coffee with the breakfast, a tumblerful of water, porter, beer, or other suitable drink with the mid-day meal, two or three cups of tea at teatime, and another tumbler of suitable liquid with the supper or while undressing at bedtime, and an improvement will very soon be observed. The water may be hot or cold, plain or aerated, Salutaris, Apollinaris, seltzer, soda-water, or other alkaline water, linseed tea, or barley-water, which may be flavoured with any

kind of fruit juice or syrup to the patient's taste, but the water should be as free as possible from salts of lime.

When the constipation is due to chronic intestinal catarrh, mucous colitis, or some obstructive cause—*e.g.*, cancer or stricture of the bowel—the coarse and bulky vegetables must be avoided entirely. The food should be more concentrated than in ordinary constipation, materials which leave little residue being preferred. We may then allow soup, fish, game, poultry, fat ham or bacon, cream, butter; a little bread or potato, vegetable purée, spinach, vegetable marrow, squash, cauliflower (without stalk), green peas, kidney beans; milk, milk puddings, custard, jelly; a little farinaceous material, as fine oatmeal, biscuit powder, corn-meal, biscuit or zwiebach, and honey or treacle; stewed fruit, strawberries, grapes, bananas, oranges, baked apples, stewed pears and prunes. The more threatening the obstruction becomes, the more necessary it will be to give a diet as free as possible from residue, such as milk, milk jelly, meat jelly, wine jelly, strong broth, ox-tail soup, lean and tender meat free from skin and gristle, chicken, chicken panada, and light fish. We must endeavour to secure regular evacuation of the bowels by the waters which contain sulphate of soda or by enemata.

The clothing must be warm but light; flannel of thickness proportioned to the season should be worn next the skin. Tight corsets or belts must be abandoned, and the under garments should hang from the shoulders instead of the hips. The feet must be kept warm and dry by good boots of moderate thickness, having an internal sole of cork or asbestos.

Nothing renders constipation more obstinate than the repeated use of purgatives; indeed, the persistent use of such drugs must of necessity cause catarrh of the bowels. Enemata of plain water, soap and water, demulcent liquids, like tragacanth or linseed tea, decoction of marsh mallow root or slippery elm bark, are proper to use. Olive oil injected at night and allowed to remain in the bowels will soften hard or scybalous masses. Glycerine suppositories or injections are a sufficient stimulant to the rectal tissues in some cases, and in children a soap suppository usually acts quickly. If aperients must be used, the best are sulphur, senna, castor oil, and the saline aperient waters of Carlsbad, Friedrichshall, Hunyadi Janos, Pullna, or Condal, and others

containing the sulphates of magnesia and soda ; but it is better, if possible, to act upon the bowels by alteration of the diet rather than by aperients. Tonics are proper when constipation arises from atony of the muscular tissues. Manipulations of the abdomen should be performed every morning for ten minutes on getting up, after emptying the bladder.[1] These consist of deep and firm pressure or kneading, and rubbing the abdomen in a circular manner from right to left along the course of the colon ; it can usually be done by the patient. Now also is the time to drink a tumblerful of cold or hot plain water or a dose of aperient water. The patient should have a cold or tepid bath or a sponge down every morning, followed by brisk rubbing of the entire body, and particularly of the abdomen, with a flesh glove or a rough towel. During the day and at bedtime various exercises of a gymnastic character, designed to strengthen the abdominal muscles (see 'Diseases of the Liver'), should be performed for five or ten minutes. Brisk walking, golf, tennis, and horseback riding, are proper exercises, especially for those of sedentary occupation. But above all things the sufferer must give prompt and regular attention to 'the call of Nature'; even going to stool regularly to solicit Nature may in the end bring about the desired evacuation.

Electricity is useful in constipation of an atonic character. The induced current will stimulate the abdominal muscles, but is insufficient to put in action the unstriped involuntary fibres of the intestine, especially when distended with gas or fæces; the continuous current will, however, arouse intestinal action, even when disease has weakened the muscles and diminished their excitability.[2] The poles should be applied along the course of the lumbar and sacral nerves to the region of the liver and along the large intestine. Each séance should last twenty minutes, and be repeated every day for two or three weeks. Electricity shortens the treatment by improving the nutrition of the mucous membrane, relieving blood-pressure, promoting metabolism, and giving tone to the muscular fibres.

Hydropathic treatment is useful. A wet compress may be applied over the abdomen every night, and bound on by a flannel bandage; a sitz-bath or cold sponging and friction should follow its removal in the morning. Once a day a douche of cold water

may be administered to the loins and abdomen by means of a jet of water from a tap ; the stream should be allowed to play with considerable force for ten or fifteen minutes, and be followed by brisk friction with a towel and massage.

DIARRHŒA AND DYSENTERY.

A too frequent evacuation of the bowels may be due to many causes : the commonest are irritating food and impurities in the water or air. It may also be produced by chill or nervous influence, enteric catarrh, dysentery, cholera, malaria, typhoid or tubercular ulcerations, lardaceous disease, and various poisons in the blood. As in constipation, the term 'diarrhœa' is a relative one. Some healthy persons are regularly moved two or three times a day, and do not feel so well when they are not ; but people who are usually only moved once a day or on alternate days when in health would consider two or three evacuations in a day to constitute diarrhœa, even though the stools were only soft and mushy. Much depends upon former habit and the cause of the disease. Looseness of the bowels is very common in the tropics during the rainy season and at other times, owing to atmospheric changes. Some people there may be said to be never free from it ; two or three evacuations occur every morning with a little griping pain. In such cases it may be salutary, especially when it follows excessive or unsuitable food. But whenever it continues throughout the day it should be regarded with suspicion, as tending towards dysentery or cholera. The mildest form of **dysentery** is attended with griping pain and bloody stools at intervals ; but in very acute cases the pain is of a cutting character, the abdomen tender, the evacuations very frequent, and perhaps contain patches of mucous membrane. 'We eat or drink **cholera**'—that is to say, the cause is some poison which enters the body with the food, such as bad water, used for drinking, cooking, or washing the utensils. Diarrhœa and cholera are most common in the summer or autumn, but they are promoted by alternate hot and wet weather, and checked by drought, heavy rain, or severe cold. They are most likely to affect people already broken down by disease, want, chronic alcoholism, and other conditions of ill-health. The better the

water-supply, the drainage, and sewage disposal in a district, the less likely are they to occur. When a case of cholera occurs, the chief features are profuse watery evacuations from the bowels, looking like rice-water, vomiting, suppression of urine, pain and cramp in the extremities, coldness and blueness of the skin, and general collapse.

The **stools** or evacuations in a case of diarrhœa necessarily vary in character with the cause; in **bilious** diarrhœa they are hurried through the canal before time has been given for reabsorption of bile pigment, and they are consequently stained a brown or greenish-brown colour; in **lienteric** diarrhœa the food is hurried rapidly along the canal, and curdled milk or other undigested food appears in the stools; in **colliquative** diarrhœa it is a profuse exhausting liquid discharge; in **dysenteric** there is much mucus and a frequent profuse discharge of blood; in **choleraic** the stools are profuse and liquid, having the appearance of rice-water; in **fermentative** diarrhœa they may be frothy or yeasty; and in typhoid and other diseases they are characteristic of the complaint.

The **treatment** of acute diarrhœa consists of absolute rest in the recumbent posture, avoiding movements of the body, and the application of warmth to the abdomen to give relief from griping or cramping pain. The administration of an aperient such as castor oil or rhubarb is an extremely useful measure, by removing the remnants of food or decomposing material which may irritate the mucous membrane. The **diet** should consist of boiled milk, plain or peptonized; it may be drunk cold if it is preferred so, and diluted with barley-water, lime-water, or one of the aerated waters. The milk may have rice boiled in it (**rice-milk**), or may be thickened with a farinaceous material, such as arrowroot, cornflour, or biscuit powder; the white of an egg may be put in each $\frac{1}{4}$ pint, and a little flavouring of nutmeg or cinnamon. Sometimes milk in any form disagrees with cases of diarrhœa; the patient may then have sago, tapioca, or rice, cooked in water until it is a jelly, and flavoured with nutmeg or cinnamon; cream should be added after cooking. They may also have soup or meat essence thickened with flour, ground rice, or arrowroot. The best beverage is milk with an aerated water; but if milk does not agree, a little port wine, brandy, or

whisky, well diluted with an aerated water. When the diarrhœa is considered to be due to malaria, it is not advisable to check it, as this is one of Nature's ways of getting rid of it. Milk does not always agree with young children who have diarrhœa; we may then have recourse to veal broth, chicken broth, or the white of an egg in a teacupful of boiled water, with a quarter of a teaspoonful of common salt and as much brandy, which mixture may be given freely.

In acute forms of dysentery, with cutting pain and tenderness of the abdomen, hot applications, such as poultices, fomentations, or turpentine stupes, will be soothing; the application of a few leeches to the abdomen is often beneficial. Vomiting may be checked by a mustard plaster over the pit of the stomach. The diet should consist of weak gruel, milk, raw eggs, weak broth, barley-water, and other demulcent drinks, and a little wine or diluted spirit may be necessary. Washing out the bowels by a simple douche of hot water or an alkaline or disinfectant lotion is sometimes beneficial.

When cholera attacks a person, the treatment should be the same as for acute diarrhœa; vomiting may be checked by ice, ice-water, effervescing draughts, brandy-and-soda, or champagne in small quantities. Collapse must be met by wrapping the patient in blankets, applying hot bottles to the feet and sides, and a hot-water bag or bran-bags to the abdomen; cramp by friction to the limbs with mustard, cayenne pepper, or warm embrocation. Light nourishing food, consisting of eggs, milk, junket, custard, jelly, may be given as soon as vomiting is abated.

When the diarrhœa is passing off, we must allow a gradual return to ordinary diet, by first giving clear soup, mutton or chicken broth, with a little dry toast or stale bread in it; then custard, blanc-mange, or milk pudding; next day a sole, plaice, or whiting, with a little mashed potato; then boiled mutton or chicken. Care should be taken in future to avoid indiscretions in food, which may have caused or aggravated the complaint.

In **chronic diarrhœa**, whatever the cause, the patient must *avoid* fat and greasy dishes, rich food in general, especially pork and veal, coarse and tough meat, hashed meat, beef-tea or strong meat essences, because they maintain the diarrhœa; salted or

dried meat; pies, pastry, sweetened foods, and confectionery; sweet wines, fruit syrups, and malt liquors. All food must be avoided which leaves a large and bulky residue in the bowels, as cabbage, savoy, salads, and many other vegetables; nuts, brown bread, oatmeal, potatoes, sweet potatoes, yam, artichokes, and all laxative fruit, such as rhubarb, figs, prunes, dates, and most kinds of raw fruit.

Allow a milk diet in preference to others; but all food which is concentrated, small in bulk, unirritating, and leaves but little residue, may be given, and *practically anything which has been passed through a fine hair sieve.* Milk should be boiled, but may then be drunk warm or cold according to taste, and alone or with lime-water, barley-water, or an aerated water. Peptonized milk, peptonized milk gruel, milk-jelly, blanc-mange, custard, junket, and milk in the form of broth or soup, are suitable. Soup or broth of mutton, beef, veal, or fowl, thickened with flour, arrowroot, cornflour, or revalenta, may also be taken. Milk puddings of sago, rice, tapioca, arrowroot, macaroni, and plain biscuits, cracknel, crackers, zwiebach, and dry toast are also permitted. Eggs may be taken either poached, boiled, or scrambled; also light kinds of fish (steamed), tripe and sweetbread. Chicken panada is serviceable. Meat such as beef or mutton can be taken raw, scraped or pounded, either alone or in jelly or port wine. In many instances we may allow a *little* underdone beef, mutton, fowl, or pheasant, but it must be entirely free from skin, fat, and gristle, and the total amount should not exceed 3 ounces a day, to be taken at two meals. The drink which is taken in addition to milk should not be a large quantity, and may consist of a little tea, cocoa, diluted spirits, sloe wine, or other good red wine. As recovery takes place we may make experiments from time to time with fish, chicken, or boiled mutton, a few grapes, a banana, tomato, baked apple, and so forth; but extreme care is necessary, especially in chronic dysentery and malarial forms of the disease. In every case the meals should be small, and the food is less likely to cause looseness when taken cold or nearly so. Warm clothing is very necessary, and a flannel bandage around the abdomen is essential.

ENTERIC CATARRH.

Catarrh of the intestinal mucous membrane, especially the chronic form, is a very frequent disease. It is very often the result of *local irritation—e.g.*, abuse of purgatives, improper or indigestible food, retention of the fæces in chronic constipation. Disturbances of the external circulation may cause catarrh of the intestines, which sometimes happens after severe burns or other injuries to the skin; chronic intestinal catarrh may result from living in a cold, damp climate, or the long-continued action of coldness of the feet, lower extremities, or abdomen. The acute form of catarrh of the bowels often follows mental excitement, distress, worry, and other severe nervous influences; long-continued mental trouble, worry, anxiety, or overwork is also a factor in causing many cases of chronic catarrh of the bowels. As a secondary affection it results from diseases of the liver, heart, or lungs, which obstruct the circulation through the principal veins and dam the blood up in those of the intestines, when congestion and intestinal catarrh is a frequent and common result. Severe or prolonged gastric disturbance, gastric catarrh, ulcer or cancer, may cause it. It is sometimes the result of chronic toxic conditions of the blood, such as uræmia, lithæmia, or malaria; and it is almost a constant accompaniment of ulceration of the bowels, especially of the colon, and of stricture or cancer.[3]

In **acute intestinal catarrh** diarrhœa is the chief symptom; the mucous lining is congested and swollen, large quantities of mucus are secreted, and epithelial cells are easily detached. The irritation of the mucous membrane induces increased intestinal movement, with frequent passage of loose or liquid motions of a pale yellow or greenish colour, containing flakes of more or less solid matter and masses of mucus; the motion may also contain particles of undigested food, bacteria, and detached portions of the superficial lining.[4] Pain of a griping, colicky nature occurs spasmodically, and vomiting sometimes occurs. It usually subsides in a few days with the treatment detailed under 'Diarrhœa.'

In **chronic intestinal catarrh** there is a considerable thickening

of the mucous lining, with reddish-brown or slate-gray patches; the glands and follicles are enlarged and covered with a tough gray secretion, and the muscular coat is frequently thickened. Severe forms of the disease lead to ulceration; but this is most likely to occur in parts of the bowels where the fæces have been lodged or delayed, as in one of the flexures of the large intestine or in the neighbourhood of the appendix. Such an ulceration proceeds from within outwards, so that local peritonitis may occur and thereby prevent perforation, although it may cause an adhesion to a neighbouring organ. When catarrh is recurrent, the patient is liable to perityphlitis or appendicitis.

The chronic intestinal catarrh of children nearly always runs its course as an obstinate and exhausting diarrhœa, which is liable to be mistaken for tuberculosis of the intestine or mesenteric glands, because the child wastes rapidly, the fat and muscles disappear, the skin hangs loosely, and he has a wizened and wrinkled countenance. This is nearly always the result of improper feeding; the child thrives well while at the breast, but when he is deprived of his natural nourishment and fed upon poor milk or milk-pap, and has a crust or a dummy-teat thrust in his mouth to quiet him, he soon becomes ill. It is only by correct feeding that such a condition can be prevented.

Adults with chronic intestinal catarrh are usually constipated. The tough masses of mucus hinder absorption and nutrition, and the patient becomes in consequence pale, thin, and weak. When decomposition takes place in the intestinal contents, gases are generated which distend the bowels and cause distressing flatulence, as a result of which the abdomen becomes distended and impedes the breathing by its pressure upon the diaphragm, and the circulation in various organs becomes disturbed—*e.g.*, the brain—so that there is mental disturbance or a nervous condition similar to that in gastric catarrh. The flatulency and disturbance of nutrition, the constipation occasionally varied by diarrhœa, the physical and mental discomfort, may proceed to such a degree as to render the sufferer unfit for active physical or mental work.

The general symptoms of catarrh of the alimentary canal are usually present, the secretion and activity of the stomach may or may not be affected, there is usually a diminution in the

amount of hydrochloric acid present, but no general rule can be laid down.[5] The abdomen, however, is nearly always tender on pressure, either generally or along the course of the colon. It is usually the irregularity of the bowels which causes the patient to seek advice. Constipation is the rule, but in some cases there is such an increase in the secretion of mucus and acceleration of movement as to constitute diarrhœa.[6] The evacuations are often preceded by colic, and the stools are pale and free from bile, or contain undigested food (**lienteric diarrhœa**) or large quantities of mucus or bloody mucus. Catarrh of the small intestines may be attended with excessive secretion and movement, causing loud gurgling and rumbling in the abdomen, owing to movement of liquids and gases in that area; nevertheless, the patient may be constipated, because time is given for absorption in the lower bowel. Where the catarrh chiefly affects the colon (mucous or membranous colitis) much mucus appears with the stools. Mucus from the small intestines is usually mixed in the motion; but that from the large intestine covers the fæces, or may be evacuated alone, or be accompanied with flaky mucus, or membranous pieces of the epithelium, or even a fibrinous cast of some portion of the bowels. The abdominal circulation is defective in most cases, and in consequence of this sluggishness, especially through the veins, the hands and feet or the general surface of the body are nearly always cold.

Few chronic diseases have a wider ramification, or produce more serious or persistent ill-health than chronic enteric catarrh. The patient has usually been in ill-health for months or years, with intermissions, before advice is sought. What was originally only a sensitive condition of the mucous membrane, with patches of congestion here and there, develops into a chronic inflammatory process, with lowered nerve tone and really serious degeneration of the health, perhaps with profound nervous debility, anæmia, and secondary diseases of the heart or kidneys. The affection is a stubborn one, difficult to cure, and decidedly rebellious to the unaided action of drugs in all cases serious enough to badly affect the health.[7]

Drug treatment of the constipation—that is, by aperient pills and waters—is generally worse than useless, because they aggravate the complaint; and the dietary recommended for ordinary

constipation is by no means suitable for these cases. A similar remark applies also to the treatment of diarrhœa. Astringents are only of temporary value, and frequently do harm; but when chronic catarrh or mucous colitis causes persistent diarrhœa, it is proper to keep the bowels clear of scybala and offensive or fermenting substances by castor oil or enemata.

The **diet** is a matter of the greatest importance; it should not consist of the same articles recommended in the section on Constipation, but of substances as free as possible from any indigestible or irritating residue; it must especially be free from fibrous material, and the cellulose coverings and fibres of vegetables and the seeds of fruits; indeed, nothing should be swallowed that has not been passed through a fine sieve, or rendered so fine by mastication in the mouth that it is of a creamy consistence, and would pass through a sieve without residue.[8] It is necessary, therefore, to *avoid* all skins, strings, stones, and bones; all skin and fibrous portions of flesh, fowl, and fish, scales of fish, the core of apples and pears; skins of potato, tomato, and other fruit; the white, pulpy portion of oranges; the seeds of grapes, currants, strawberries, gooseberries, figs, and other fruit; the fibrous portions of vegetables like cabbage, savoy, seakale, cauliflower, turnip, carrot, or parsnip, except such portion as has been passed through a hair sieve; also all salted, smoked, or dried meat, hard-boiled eggs, cheese, brown bread, rye-bread, coarse oatmeal, hot buttered toast, new bread, crumpets, muffins, pastry, boiled pudding; nuts, almonds, dried raisins, and currants; peas and beans; sardines, pilchards, and whitebait.

Generally speaking, anything *may be allowed* in the form of fish, meat, game, fruit, or vegetable which has been passed through a hair sieve.[9] The patient may have stale bread which crumbles under the finger and thumb (*avoid crust*), bread-and-butter, plain biscuits, crackers, or rusks, providing they are masticated to the consistence of cream before they are swallowed; also sponge cake, Madeira cake, and dry toast if well masticated.

Soup thick or clear may be allowed. All kinds of herbs or vegetables may be boiled in the soup, providing they are removed; or a consommé may be made by boiling meat and all kinds of vegetables together for a long time until the whole is a jelly

and then straining it for the patient; or soup may be flavoured with essence of celery, ketchup, or tomato sauce; vermicelli or macaroni may be cooked in it, or a little dry toast or bread eaten with it.

Flesh.—The patient may have the gravy from any kind of meat; also tongue, potted meat, scraped meat, poultry or game light fish, and raw or soft-boiled eggs. As the treatment goes on, we may experiment with food which has not been passed through a sieve, such as sole, plaice, whiting, brill, or turbot, avoiding the skin, bones, and heating sauces; then with rabbit, chicken, or pheasant, taking care not to swallow skin or sinew; finally with mutton or beef, cutting out every particle of skin and stringy or fibrous material. Boiled tongue and potted meat are very suitable forms of meat for these cases.

The **vegetables** allowable are vegetable marrow, spinach, purée of potato or well-mashed potato, and any other vegetable which has been passed through a sieve. In mucous colitis, Von Noorden considers a diet rich in cellulose, therefore of coarser vegetables, is better than resting the organ.[10]

Pudding.—Rice, sago, tapioca, providing they are perfectly soft; also cornflour, arrowroot, blanc-mange, custard, junket, and farinaceous materials, such as fine oatmeal, revalenta, and other prepared foods, especially those containing milk powder. All kinds of jelly are admissible, providing they contain no solid substances like fruit, and the **syrup** of jam or marmalade, honey, treacle, apple, quince or guava jelly.

Fruit.—Cooked apples or plums, a ripe banana, or a few grapes, care being taken to remove all skins and stones, cores and fibrous portions. Pears are forbidden because they contain numerous small, hard particles, besides the core, which are irritating. Raspberries, strawberries, currants, and oranges can be rubbed through a sieve to remove skin and seeds; they may then be sweetened, and eaten alone, with cream, or as an accompaniment to milk pudding.

Drink may consist of China tea or coffee in moderation, of cocoa freely, or acorn cocoa in cases of diarrhœa; milk, cream, butter-milk, whey, or water. Milk should be drunk freely, and in many cases it must be one of the staple foods, when, of course, 4 pints a day would be considered a fair amount; if it is not

well borne, it may be mixed with a farinaceous food, or peptonized, or given with lime or barley water, or one of the natural alkaline waters, or with a gaseous water, such as soda or potash, to prevent the formation of hard, indigestible curds, which would be a source of irritation. Plenty of water or other liquid is an advantage in constipation, but may be a disadvantage if diarrhœa is persistent.

When diarrhœa is a marked feature of the disease milk is not always tolerated; neither is beef-tea, nor meat or vegetables, even in the form of purée or consommé. We must then begin by giving a farinaceous diet of gruel made of the finest oatmeal, baked wheat flour, cornflour, revalenta or biscuit powder, or rice or sago done to a jelly, one of the forms of **milk powder** being mixed with these to supply proteid material. Other proteids may be given in the form of an egg every four or six hours, raw, poached, or soft-boiled; or the white of an egg beaten up may be given in a little lemon-water or in farinaceous food; and raw meat juice or meat jelly (of which several good kinds are sold) may be given. When a little improvement is made, and these foods are borne without increasing the diarrhœa, we may experiment with others, such as a little scraped meat, light fish, tripe, sweet bread, tongue, and mashed potato; but we must proceed cautiously, gradually increasing the variety and solidity of the food until the list is similar to that given above. Cloves, cinnamon, and nutmeg are useful flavouring agents of benefit to the patient; red wine, such as sloe or whortleberry wine, a little good old port or Hungarian, may also be allowed.

A form of intestinal catarrh called **hill diarrhœa** occurs in certain elevated districts in many regions of the earth, as, for instance, in the Himalayas or Neilgherries of India; it may be due to malaria, fever, insanitary surroundings, the rainy season, strumous habit of body, or to having newly arrived in the district.[11] **Sprue** is also a chronic form of enteric catarrh occurring in the tropics, in which there are erosions of the mouth and dribbling of saliva, pain in eating and swallowing, and frequent motions are passed without pain or straining. The treatment of these must be on the lines already laid down, but food must consist chiefly of milk, rice-milk, white of eggs, arrowroot, cornflour, weak animal broth, *soup made from liver*, raw meat juice or

jelly, calf's-foot jelly, and minced meat. Liver soup is especially recommended; and **toddy**, the fermented juice of the cocoanut palm, is said to be a specific. Many cases of enteric catarrh do well so long as only unirritating food is taken; in others no kind of vegetables can be taken in their ordinary form until long after the stools have become normal, for there is frequently a return of diarrhœa or of mucus after a few meals containing them. Sprue and hill diarrhœa are such cases; while the patient keeps to a milk diet he is moderately well, but very frequently any divergence from that leads to trouble; and although milk is considered by most practitioners as the best food for such people, Cantlie[12] condemns it and considers it to be unsatisfactory. He recommends a *meat diet* as being far better than milk, and some others agree that meat cures quicker than milk. Cantlie recommends the patient to begin with meat juice, then beef jelly or calf's-foot jelly, and pounded meat; and by the sixth day the patient should take three meals, each consisting of 4 ounces of finely-minced beef; and on the eighth day meat from any joint or chicken may be taken, but the under-cut of roast beef is the best. China tea, or tea made from *roasted rice*, may be taken. As soon as the stools are fairly solid vegetables are allowed, especially vegetable marrow, stewed celery, or seakale; also pulled bread and baked bread—the latter consisting of thin slices of bread which have been baked in a hot oven for about twenty minutes until they are dry and crisp. Suet puddings and rice, cooked as it is for a curry, may be eaten quite early in the treatment, but it is a long time before milk puddings can be taken by all patients. Strawberries were highly recommended by Thin as a cure for sprue, and this receives the support of Manson and Cantlie; they are not to take the place of other food, but may be eaten between meals to the extent of 3 or 4 pounds daily.

Hygiene.—It is absolutely necessary to keep the bowels clear, to prevent fermentation or decomposition and subsequent absorption of toxins or an increase of the catarrh. In chronic diarrhœa a teaspoonful of castor oil or a small dose of sulphur every morning is useful for this purpose; they act as muscular stimulants, help to check the looseness, and are not so depressing to the general system as many aperients. When constipation is

a marked feature of colitis or enteric catarrh a large daily dose of castor oil is the best aperient, and the effect of taking it day by day is sometimes marvellously curative. In other cases injections are far better than aperient pills and medicines given by the mouth. Hard masses of fæces are best softened by injections of olive oil when going to bed. *Cleanliness* of the bowel is essential, and this is best obtained by douches or injections of hot normal saline solution, boracic lotion, oatmeal water, or other demulcent liquid, like decoction of marsh mallow root or slippery elm bark, or infusion of tragacanth, to which some boracic acid is added; these solutions should be used hot, at 105° to 110° F., when they will have the same sedative effect as a fomentation, and improve the circulation of the whole abdomen. At Carlsbad these cases are treated by douches of 3 litres of the Sprudel natural water at 45° C., which is poured into the bowels from a height of 85 centimetres; the patient lies upon the side while a long, soft rubber tube is inserted as far as it will go without bending by a gentle twisting movement, the outer end of the tube being attached to a vessel which contains the water; the patient lies upon the back, and a warm bag is applied to the abdomen while the liquid is poured in (*Aldor*). The water of Plombières is used in a similar manner, and is highly recommended by Brunton. The first douche consists of 1 litre, but is increased in amount daily until 3 litres are used. Lavage, or douching the bowels, can be done at home in a similar manner with the same waters or by lotions made in imitation of them, or those named above, and this treatment is highly recommended. Herschell[13] recommends almost continuous lavage by a special apparatus.

Hot baths, followed by massage, electricity, and abdominal exercises, are also useful to improve the circulation and tone of the muscles, and a wet pack or medicated compress worn over the abdomen and bound on by a flannel bandage every night is beneficial.

The amount and kind of exercise must depend upon the nature of the case; if there is marked diarrhœa, then quietness should be the rule, fresh air being taken by sitting in a garden or driving in an easy carriage. When constipation prevails, riding, golfing, tennis, and most other out-of-door exercises, are valuable, and

gymnastic exercises assist in establishing the tone of the abdominal muscles and the circulation.

The clothing is also important; it should be neither light nor heavy, but it must be warm; the weight should hang from the shoulders, a flannel bandage should be worn around the abdomen, and woollen under-garments, of weight proportionate to the season, are essential.

APPENDICITIS.

The severe form of enteric catarrh which affects the cæcum and its appendix merits a separate paragraph. Collections of fæces in the cæcum and ascending colon cause catarrh of that region, attended by pain or tenderness, and there may be alternate looseness and constipation. These premonitory signs do not always occur, but whether they do or do not, the muscular fibres of the colon lose their power of contraction, so that the contents of the small intestine tend to lodge in the cæcum and cause catarrh. As the result of chill, over-exertion, or some undiscoverable cause, the constipation becomes complete; then there may be vomiting, first of the contents of the stomach and later of the bowels. A severe pain occurs on the right side of the abdomen, and is increased on the slightest pressure; it may extend over the whole abdomen, and sometimes alternates with intervals of ease. An examination reveals dulness and a sausage-shaped swelling in the affected region, which sometimes extends up the right side as high as the ribs. An improvement generally begins after the passage of several motions obtained by the administration of castor oil and enemata. But the disease does not always take this favourable turn; the inflammation may involve the peritoneum, the surrounding cellular tissue, or the muscles. The pain then becomes more acute and extends to the thigh, the swelling loses its sausage-shape and become broader, and the patient lies upon his side with the thighs drawn up to the body; it is now called **perityphlitis**. It also may take a favourable turn, or terminate in an abscess. Many cases formerly described as typhlitis or perityphlitis arise from disease in the vermiform appendix, called **appendicitis**, which may arise *de loco* or as an extension of catarrh from the cæcum. The appendix is an organ of lower vitality and

less resistance than the rest of the intestinal canal;[14] it is likewise a *cul-de-sac* and bodies may get lodged in it—*e.g.*, bristles, seeds of fruit, fish bones, little masses of fæcal matter, and many other substances. Micro-organisms, especially the *Bacillus coli communis*, are always present in the intestine, and at any opportune moment, as in the presence of irritating secretions, they may excite inflammation and lead to suppuration. Catarrh of the cæcum, extending to the mouth of the appendix, may cause it to swell and obstruct the passage, so that the cavity becomes distended by its own secretion, or the appendix swells and becomes infiltrated, its cavity similarly becoming distended by catarrhal products or pus. Ulceration, perforation, or gangrene of the appendix are common results; in any case the peritoneum is likely to become involved and adhesions formed. The onset of appendicitis is usually sudden, although there may have been a previous attack of catarrh of the cæcum, with obstinate constipation and severe pain. Usually the patient is seized with severe pain diffused all over the abdomen or confined to the right side, with tenderness at a particular spot; the abdomen is tense and rigid, constipation is marked, and there may be vomiting, feverishness, and malaise. If the attack continues, the pain and swelling increase, rigors and sweating occur, which indicate the formation of pus and perhaps septic absorption. When this stage is reached, relief usually only follows surgical interference. In the more favourable cases absolute rest, milk diet, ice to suck, and hot poultices or cold compresses, may subdue the inflammation; the pain and swelling then gradually subside and disappear in fourteen to twenty-one days from the commencement. Second or third attacks may occur in the same person after intervals of months or years, owing to the presence of a foreign body in the appendix or a repetition of the exciting cause. Surgical treatment is by no means necessary in all cases of appendicitis, but probably in about one-third of the whole, which include recurrent or relapsing appendicitis, suppuration, or a suspicion of diffuse peritonitis being caused by it, and in very severe attacks of acute appendicitis in young subjects.[15]

Preventive treatment will do much good in persons who have suffered from enteric catarrh, perityphlitis, and those who have had one attack of appendicitis, for which purpose careful treat-

ment, on the lines laid down under enteric catarrh, is especially important. Nothing is more likely to bring on an attack of appendicitis than the consumption of indigestible food. Meat, fish, game, and eggs appear to be harmless when taken in proper proportions, and due care is taken to avoid the indigestible portions; but it is extremely necessary, when a person has had an attack of appendicitis, to reduce such indigestible portions of food to the smallest quantity. The consumption of fruit is a matter which requires consideration; in most cases an abundance of *cooked* apples, rhubarb, plums, peaches, and pears may be taken, also grapes or tomatoes after removing the seeds; it is proper, however, to reject all berries, figs, and other fruit from which the seeds cannot be removed, lest the lodgment of these small particles should set up appendicitis, and the fact of their being occasionally found in the appendix supports the view that they do sometimes cause it. But when the bowel is healthy there need be no fear of such an untoward accident, and it is then unnecessary to curtail the dietary; on the contrary, the free use of raspberries, strawberries, currants, and grapes,[16] or other fruit, by preventing or overcoming constipation, is one of the surest means of preventing this dangerous disease. It is only when such a disease as enteric catarrh already exists or appendicitis has previously attacked a person that excessive care need be exercised in the consumption of fruit and vegetables.

Constipation is a cause of catarrh of the cæcum or its appendix and of obstruction to its canal. Fæcal stagnation leads to the formation of concretions in the cæcum or appendix, and disposes to bacterial development, fermentation, putrefaction, and mild or severe inflammation. Proper regulation of the diet will insure relief from constipation, and by securing good intestinal drainage, with more or less antisepsis, will materially reduce the risks of appendicitis. Plenty of liquid should be taken. There is nothing so important to digestion and elimination as water for all people in health and disease; but a large proportion of civilized people do not take enough. It should never be forgotten that 4 pints of liquid are required daily to supply the loss of water through the skin, lungs, and kidneys. Allowing 1 or $1\frac{1}{2}$ pints to be consumed in the food, $2\frac{1}{2}$ to 3 pints should be drunk daily. Pure water is by far the best; but other beverages may be

allowed. If people would drink more, there would be fewer cases of enteric catarrh and appendicitis.

Exercise is good in all other conditions of health or ill-health. But excessive muscular effort in rowing, running, jumping, or cycling has been a factor in causing appendicitis in people predisposed to it, and should be guarded against.

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CHAPTER XXIII

DEFECTS OF METABOLISM

Gastric digestion consists of the conversion of proteids to peptones. Starch and sugar are also broken down in the stomach, cane-sugar is converted to dextrose, and the product is gradually transferred to the intestines. The acid chyme mingles with the alkaline bile and pancreatic fluid. Bile precipitates the proteids and prepares them for the action of the pancreatic ferments; it also emulsifies and saponifies fat. The pancreatic fluid converts starch into sugar (maltose), and proteids into peptones, leucin, and tyrosin. The products of digestion are absorbed by the tributaries of the portal and lymphatic systems. The greater part of the proteids—sugar, salts, water, and a little fat—reach the liver, where some of the proteid and most of the carbohydrates are stored. The functions of the liver are the production of glycogen, urea, and bile. Glycogen is the form in which carbohydrate is stored in the liver. It accumulates in the liver cells, and so prevents the system from being flooded by it after each meal, and is reconverted by an enzyme into sugar as it is required for use. Urea is the end-product of nitrogenous

metabolism in man, and under normal circumstances it is practically the only way in which nitrogen leaves the system. All proteids are decomposed into it. The partially oxidized nitrogenous substances which are excreted may be considered as antecedents of urea. Bile is secreted by the liver, mingles with the food in the bowels, and assists in chylification. Some of the bile leaves the system with the fæces ; but most of the bile salts are reabsorbed from the bowel, and re-enter the liver by the portal vein, to be again formed into bile. There is thus a bile circulation from liver to bowels, through the portal vein, and back again to the liver.

The production of urea is a very important function of the liver. As a general rule the urea excretion is equivalent to 0·5 gramme per kilo of body-weight, and averages 33 grammes per diem in a man weighing 150 pounds. Its production is naturally influenced by the kind and amount of food taken, and somewhat by the work done. Most urea is excreted when proteid food alone is taken ; it may then rise to 80 grammes per day. Least urea is excreted when carbohydrate food alone is taken, when it may sink to 18 or 12 grammes. When no food at all is taken—that is, in starvation—there is still an excretion of about 10 grammes per diem. Rest or work does not make much difference to the urea excretion, providing the usual food is taken and proper metabolism is maintained. During rest it falls a little below the normal, and during an ordinary day's work it rises to 37 grammes per day. Now, 1 gramme of urea contains as much nitrogen as 3 grammes of proteid. If, therefore, 33 grammes of urea are excreted in twenty-four hours, there must have been a consumption of 99 grammes of proteid. The amount of proteid used by the body can be roughly estimated by the daily output of urea, for when all the proteid eaten is assimilated it causes an excretion of an equivalent amount of urea, or else it adds to the weight of the body by the formation of fat. *A nitrogenous equilibrium* is said to be established when the amount of urea excreted represents the quantity of proteid eaten, the body neither losing nor gaining weight.

Although the ultimate destination of all the proteids of the body and of the food is to be eliminated as urea, carbonic acid, and water, they pass through various stages before they arrive

at the lowest terms. Bodies in the intermediate stage are creatin, creatinin, sarcosin, carnin, leucin, tyrosin, glycin, xanthin, hypoxanthin, and uric acid. The intermediate bodies are contained in or produced from our food and the cellular tissues of the body. The oxidation which goes on in the muscles reduces some of them to uric acid and urea; but others escape from the muscular tissues in the intermediate forms. The kidneys have the power of reducing uric acid; but the work of completing the destruction of proteids falls chiefly upon the liver, which is the great depurating organ of the body. Creatin, leucin, tyrosin, etc., are types of partially oxidized nitrogenous substances. It is impossible to say whether their metamorphosis proceeds on the same or different lines, but the end-product is chiefly urea. Leucin and tyrosin are the result of the pancreatic digestion of proteid. Creatin is always found in muscle and urine, but the amount in the urine is never sufficient to represent that formed in the muscles. Some of it is decomposed into sarcosin and urea.[1 2]

The alloxur, or **purin bodies**, include uric acid, xanthin, hypoxanthin, adenin, guanin, and methylxanthin (*i.e.*, caffeine and theobromine). These substances arise from nucleo-proteids, which are compounds of proteid with nuclein found in the nucleus and protoplasm of cells. Nucleo-proteids contain a high percentage of phosphorus, and most of them also contain iron. Indeed, the normal supply of iron and phosphorus for the body is contained in the nucleo-proteids, or hæmatogens, of animal and vegetable cells. In the system, nucleo-proteid splits into proteid and nuclein; nuclein into proteid and nucleic acid; and nucleic acid into purin bases, phosphoric acid, etc.[3] By their oxidation, therefore, the purin bodies give rise to uric acid. Now, uric acid is **trioxypurin**, and is normally excreted by human beings to the extent of 1 gramme per day. It is derived from the nuclei of cells and from the other purin bodies. Certain forms of food increase the production of uric acid by leading to excessive formation or destruction of leucocytes. It is also manufactured synthetically in the body by the union of glycin with urea, and ammonia with lactic acid. But the main source of uric acid and other purin bodies is the nuclein and similar substances in the food. Uric acid is the form in which nitrogen

is normally excreted by slow-breathing reptiles; and an excess of it occurs in the urine of people who eat too much proteid food and take too little exercise, or in feverish conditions (in the form of urates), when the demand for oxygen exceeds the supply. The formation of uric acid in man, when it exceeds 1 gramme a day, must be looked upon as unnatural or as a divergence from the normal lines of metabolism. We know that various organs in the body have for one of their functions the destruction of organic material. The spleen is such an organ. It removes from the blood the red corpuscles which are unfit to make a tour of the body and perform their functions, and their destruction is a source of the purin bodies. Extract of spleens clearly show that such destruction takes place there, for uric acid, leucin, xanthin, hypoxanthin, etc., are abundant in it. These substances are carried by the blood from the spleen to the liver, and are normally converted into urea. It is only when the transformation of such substances into urea is interfered with that uric acid is formed and excreted to excess. Uric acid and all other purin bodies therefore exist in our food—such as meat, fish, beef-tea, gravy, meat extract—and are formed from the nuclein or nucleo-proteids which exist in all animal and vegetable cells.

The **purin bodies** are endogenous or exogenous, according as they are formed within the body from its own cells or tissues or taken into the body with our food. The **endogenous** purin is formed in the body from the destruction of the cellular elements and from metabolic processes incurred in maintaining the bodily functions. About 50 per cent. of it is transformed by the liver into urea and 50 per cent. is eliminated by the kidneys as uric acid and its allies. The **exogenous** purin, which is taken into the body with the food, is also excreted as uric acid and its allies to the extent of 50 per cent., and the remaining 50 per cent. is transformed by the liver into urea. But all the purin consumed with the food is not absorbed into the system. There appears to be a personal equation in the matter, one person being able to absorb more purin bodies and nuclein than another. There is a normal daily excretion of purin bodies in the fæces, called the **fæcal purin**, to distinguish it from that which is excreted by the kidneys, and called **urinary purin**. The amount of fæcal purin necessarily varies with the kind of food taken,[4] and is much

greater when substances are eaten which are rich in nuclein and its purin derivatives. It was found by Walker Hall[5] that when a person ate 500 grammes of sweet-bread, 60 per cent. of the purins were absorbed and 40 per cent. were voided in the fæces.

The *excretion* of purin is also influenced by the kind and amount of food, the quantity varying with meat, milk, or vegetables. With *ordinary diet* the exogenous or nutritive purin remains the same in most people; that is to say, the same ability to absorb it existing in all people, the excretion will be the same. Most purin is excreted with a vegetarian diet, because of the large proportion of nuclein which it contains. Least purin is excreted when the food consists solely of milk, eggs, cream, butter, cheese, rice, potato, *green* vegetables, and white bread, which form *a purin-free diet.* Meat, and especially sweet-bread, milt (spleen), brain, liver, and kidneys, causes a considerable increase in the amount of purin excreted. The percentage of purin substances in beef and veal is 0·06, calf's liver 0·12, calf's spleen 0·16, calf's thymus 0·4, and in coffee 0·2. They cause an excretion of exogenous purin in the urine equal to—beef and veal 0·03 per cent., liver 0·06, spleen 0·08, thymus 0·1, and coffee 0·075.[6] Uric acid, leucin, xanthin, and hypoxanthin are abundant in spleen; nuclein, xanthin, hypoxanthin, guanin, and adenin are all excessive in sweet-bread; lean meat contains xanthin, hypoxanthin, sarcolactic acid, and other extractives; liver is rich in glycin, uric acid, and all the other purin bodies; beef-tea, gravy, and extract or essence of meat contain a large proportion of such substances. The consumption of all these materials as food must increase the amount of purins in the body, and unless the excretion of uric acid and the allied purins take place in proportion to the consumption, they accumulate in the system and cause disease. Tea, coffee, cocoa, and all the vegetable stimulants, contain caffeine or theobromine—that is, methylxanthin—and their consumption increases the exogenous or nutrition purin, which affords an explanation of their injurious effect in such a disease as gout. Many vegetable foods, such as peas, beans, and asparagus, likewise contain a large proportion of purin bodies, and, if eaten, increase the amount of purin in the body. We have already observed that about 50 per cent. of the purin bodies absorbed from the food, or originating within the

body from the destruction of blood and other cells, is transformed by the liver into urea and excreted in that condition. The remaining purin bodies are oxidized and excreted by the kidneys as uric acid, oxaluric acid, allantoin, hypoxanthin, xanthin, etc. A purin-free diet, such as that given above, does not give rise to purin bodies in the urine, and when a patient is entirely fed with it for a space of time, whatever purin is found in the urine must arise from the destruction of nuclein derived from his own tissues, and this amount, being ascertained, is taken as the measure of endogenous purin formation ; in other words, of the metabolic activity.

The total amount of nitrogen excreted daily in the fæces is normally about 1·39 grammes, and, speaking generally, the amount which can be recovered from the stools may be taken as a measure of the indigestibility of nitrogenous food or the patient's inability to absorb it. The larger the proportion of nitrogen which can be obtained from the fæces, the less completely has the food been absorbed in the alimentary canal. It varies with the diet, being greatest on a purely vegetarian diet. Thus in the case of a young vegetarian the total nitrogen in his fæces was 4·01, and in his urine 6·91 grammes daily.[7] But given the same diet, the same individual normally excretes daily the same amount of purin bodies in the fæces. This has to be estimated in experiments on general metabolism, but clinically small variations are neglected. In diarrhœa and intestinal catarrh the purin bodies in the fæces are increased by the shedding of cells from the mucous membrane ; in bronchial and pharyngeal catarrh a certain amount of nuclein is lost in the same way ; and in catarrh of the bladder a small quantity of nucleo-albumin is found in the urine ; but the remaining tissue cells pass their nuclein into the circulating fluids of the body, and it reaches the liver in the usual way, and is the chief source of endogenous purin formation.

Auto-intoxication.—Purin bodies are not the only substances in our food which give rise to ill-health when their elimination is imperfect, nor are they the only substances produced within the body which are capable of causing symptoms which must be regarded as poisoning. **Cholin** and **neurin** are substances developed from the lecithin of eggs and other kinds of food in the

intestines, more especially when the digestion is interfered with; they are also produced by bacteria acting in the same region.[8] Seeds rich in albumin contain a large proportion of lecithin arising as a product of their assimilation and metabolism;[9] they form a source of lecithin to human beings, and also of cholin and neurin when they are not properly digested and assimilated. Cholin and neurin are very poisonous, and have a powerful effect upon the nervous system; they enfeeble the circulation, induce fainting fits and fatty degeneration of the heart, which effects are often seen in general paralysis.[10]

Poisoning of the body by a substance produced within it is called **auto-intoxication**. The alimentary canal is one of the chief sources of materials which are capable of producing auto-intoxication. When the digestion is interfered with, peristalsis hindered, or absorption delayed, various toxins are liable to be produced by chemical or bacterial action. The retention of such toxic materials within the system is productive of trouble in many ways. Catarrhal jaundice is an instance of the retention in the body of substances which are not normally retained. Cholæmia may arise from several causes—*e.g.*, the absorption of poisonous products from the alimentary canal; glykæmia is associated with diseases of the pancreas; and gout is due to uratæmia.[11] Migraine and tetanus also probably depend upon auto-intoxication arising from the alimentary canal.[12] Alkaloidal substances are found in the urine, vomit, and fæces in cases of tetanus, pernicious anæmia, phthisis, and Graves' disease; and a number of products arising from the destruction of albumin pass out of the body in the urine. The chief source of the poisonous metabolic products is albumin; they include acids, gases, ptomaines, leucomaines, tox-albumins, and enzymes. Other toxic products also give rise to ammonæmia, hydrothionæmia, acetonæmia, and intoxication by organic acids.

Diseases of metabolism include insufficient assimilation and elaboration of foodstuffs, gout, obesity, diabetes, anæmia, chlorosis, etc. When, owing to defective metabolism and elimination, the human organism is unable to protect itself against toxic effects, we have diseases of the liver, kidneys, digestive disturbances, gout, lithæmia, gravel, rheumatism, nervous affections, etc.

FUNCTIONAL DISEASES OF THE LIVER.

Functional diseases of the liver are very common. If the liver is torpid the bile will be deficient, and consequently the digestion and absorption of food from the intestines will be imperfect. Not only is the bile-producing function defective, but the liver is embarrassed and unable to perform properly its other functions connected with metabolism.

The common causes of liver derangement are the food or the air, or a disproportion between the two. An excess of food, especially 'rich' food, meat, highly-seasoned dishes, sauces, and alcohol, will cause it. Sometimes it is due to an imperfect oxygenation of the blood, which is the result of deficient respiration or circulation caused by a sedentary occupation, luxurious habits, insufficient exercise, or working in hot and ill-ventilated rooms in which the air is necessarily impure. There is a combination of such causes in many cases. The effect of an absence of fresh air, light, and exercise is to cause a retention in the liver of the products of its activity. It becomes blocked with bile, urea, uric acid, and glycogen, and it is torpid in consequence. It is very often a result of town life. The derangement of the liver is manifested in various ways; the urine contains an excess of uric acid and other purin bodies, sometimes products of digestion, such as leucin, tyrosin, or sugar, and an excess of colouring matter. The bile is altered in quality and quantity; it may be in excess or deficient. There may be bilious diarrhœa with vomiting, constipation with foul and pale stools, or the bile may become concentrated or inspissated in the bile channels or gall-bladder, and form gall-stones. The general system is markedly affected by reason of the circulation in the blood of the products of disordered metabolism; the liver being unable to deal with these materials, an excess of urea, uric acid, urates, purin bodies, bile salts, and other deleterious substances which the liver ought to dispose of is circulated through the system by the general blood current. The muscular system suffers because the waste products of metabolism are not removed, and because of the impurity of the blood which circulates through them, with the consequence that weakness,

aching, weariness, and trembling are common. The skin may be tinged with yellow, itchy, and uncomfortable. The circulation of these materials through the liquids of the body affects even the sight, so that the vision is dull and little specks may be seen floating before the eyes. The sensitive nervous system is deeply impressed, so that languor, irritability of temper, depression, misery, headache, backache, drowsiness, and inability to concentrate the thoughts upon one's business, are quite common symptoms. The delicate sympathetic nerves are also profoundly impressed; flushing of the face, palpitation, intermittent pulse, irregularity of the heart, and ringing in the ears result. When the liver trouble is persistent, the disturbance of metabolism produces certain well-known states of the system, as uric acidæmia, lithæmia, gout, gravel. The lining of the joints may be irritated, and cause rheumatic gout or chronic rheumatism; the fibrous tissue of muscles and nerves may be similarly affected, and cause lumbago and sciatica. The abnormal substances floating in the blood, as the result of the abnormal metabolism, may irritate the lining membrane of the bloodvessels and heart, so that valvular diseases, hypertrophy of the heart, degeneration of the coats of the vessels, or thickening of the fibrous tissues of the arteries, may occur with increased tension, leading to Bright's disease.

Liable as the residents in temperate climates are to derangements of the liver from the causes named, the non-native resident of tropical regions is far more liable to have his liver disturbed and its functions disorganized. From the moment such a residence begins Nature endeavours to accommodate the system to the change of climate and circumstances, but not always satisfactorily. The air in the tropics is rarified, probably contains a somewhat smaller proportion of oxygen than in colder climates, and has the effect of checking the elimination of carbonic acid from the body; it is also probable that more carbon is consumed in the form of food and drink to meet the excessive perspiration. At the same time there is a constant tendency to take less exercise than is requisite, which leads to diminished combustion and consumption of material in the system. All these causes assist in overloading the liver, in producing a congestion of the portal system of vessels, with the consequence

that diseases of the liver and stomach are exceedingly common. Disease of the liver is, then, due to a combination of the hot climate, sudden changes of temperature, chills and damp, excessive eating and drinking, stimulating food, exposure to the sun, crowded dwellings, warehouses, or barracks.

Acute Congestion of the Liver results when a person gets a chill —' liver chill '—so that there is actually a plugging of the vessels of the liver and its ducts. The same thing occurs from the impaction of a gall-stone or catarrh of the bile-ducts ; some of the bile constituents enter the blood, circulate with it, and tinge the skin and tissues a lemon or orange colour, and are excreted by the urine and other secretions, which are coloured by them. Acute or active congestion of the liver is most common in people from thirty-five to forty-five years of age, especially in those who lead a sedentary life and eat and drink freely. It causes a sense of weight in the right side, or an actual pain radiating from the side to the shoulder ; slight jaundice, constipation, pale-coloured stools, high-coloured urine, furred tongue, bitter taste in the mouth, want of appetite, nausea or vomiting, aching of the limbs, giddiness, headache, languor, palpitation, sleeplessness, and other signs of physical and mental prostration, and profound disturbance of the muscular and nervous systems, are the symptoms which attend it.

Chronic Congestion or Passive Hyperæmia of the Liver.—A flow of blood to the liver occurs normally after each meal, when the absorption of food from the alimentary canal causes an increased fulness of the intestinal veins, and consequently of those which go to the liver. When people eat or drink immoderately this physiological rush of blood becomes excessive, abnormal, and lasts longer, and if the cause continues, a permanent dilatation of the vessels of the liver is induced. Spirituous liquors are conveyed directly to the liver through the tributaries of the portal vein ; the alcohol acts as an irritant to the liver substance, which becomes relaxed, and its capillaries dilate owing to a diminished resistance to the increased flow of blood through it ; abuse of alcohol in any form is a well-known cause of liver disease. A similar irritation of liver substance and congestion of its vessels is produced by the use of spices and condiments in an excessive quantity. Chronic congestion is caused in other

diseases by a backward pressure in the veins, so that the blood cannot leave the liver so readily as in the normal condition. This occurs, for instance, in valvular diseases of the heart, fatty heart, or pressure upon the veins by a new growth, or from causes of venous obstruction in the lungs, such as pleurisy and empyema. In whatever manner the congestion is induced the liver is swollen, and its cut surface presents the appearance known as 'nutmeg liver.' Definite signs do not occur beyond those of ordinary liver trouble, detailed above, unless the congestion reaches a high grade and the liver becomes considerably enlarged. There is then a feeling of fulness or weight in the side, with pain or tenderness on pressure, pain under the right shoulder-blade or in the shoulder-tip, perhaps a sense of tension over the whole abdomen, or an inability to bear tight clothing or to breathe freely. There may be a concomitant catarrh of the stomach and bowels, and a continuance of the cause, especially alcoholic excesses, will be the means of producing progressive changes in the liver, which may end in cirrhosis.

The Management of Liver Troubles.—We can influence the liver by means of its supplies of food and air. The secretion of bile, the storage of glycogen, and the production of urea can be modified within certain limits by the proportions of proteid and carbohydrates consumed. We can also control the supply of oxygen to the liver, and to some extent the intricate processes going on within it, by the purity of the air and the amount of exercise and general oxidation. We can sweep the bowel of its entire contents, removing the bile salts therein, and stimulate the liver cells to fresh secretion, whereby the sluggish organ is benefited. Purgation also diverts much water from the portal system, and thereby relieves the congestion of the veins, and we can increase the elimination of urea by acting upon the kidneys, whence we also stimulate the liver to fresh activity.

Persons subject to 'liver complaint' must revise their dietary; they must avoid rich, highly-seasoned, and spiced foods, sauces, pickles, and all other things known to cause indigestion (*q.v.*); they must live upon plainer food, and more abstemiously than has been their custom. Perfect digestion must be obtained and regular action of the bowels. Sedentary or lazy habits must be abandoned, plenty of exercise in the form of riding or walking

in the open air must be taken, the atmosphere of the rooms occupied by the patient must be cool and pure, and sunlight is essential. Sometimes a change of occupation is advisable—*e.g.*, from that in the foul, hot atmosphere of a warehouse or workroom to an out-of-door occupation or life in the country. Little more is necessary.

In acute congestion of the liver—'liver chill'—a few days' rest in bed is advisable; cotton-wool applied over the liver will be soothing; fomentations, a hot mustard and linseed poultice, followed by an ordinary linseed poultice or a few leeches to the anus, will, by drawing blood from the liver, soothe it and relieve the congestion. Further reduction of the congestion can be brought about by a large dose of saline aperient—*e.g.*, two or more Seidlitz powders in rapid succession. In this stage the diet must be absolutely unirritating: milk alone or with an alkaline water, such as soda, potash, Vals, Vichy, or Apollinaris; thin oatmeal gruel, maize mush, or arrowroot; veal or chicken broth; and a little tea. When the feverishness is gone a little boiled whiting, sole, turbot, or fresh haddock, rice or other milk pudding, and later on a little chicken or white game. If the congestion is neglected, acute inflammation may occur or an abscess of the liver form, which require similar treatment. When convalescence sets in there should be a rearrangement of the diet and habits, as indicated above. Should the congestion or hyperæmia of the liver become chronic, the dietary and habits of life must equally be rearranged; instead of free and luxurious living the diet must be plain and unstimulating, such as fish, boiled mutton, eggs, milk puddings, light vegetables, fruit, bread-and-butter, and other easily-digested foods (see 'Indigestion and Gastric Catarrh'). The diet should be spare, neither over-eating nor over-drinking, very much fat or starchy material being avoided. Alcohol materially interferes with the functions of the liver, and ought to be done without altogether or its consumption much reduced. Malt liquors and spirits are particularly forbidden, but a little light wine, as Hock, Silery, Moselle, Bordeaux, or red Hungarian wine, may be taken. Pickles and spices must be avoided. Luxurious habits must be abandoned; the patient must walk instead of riding in a carriage, although riding on horseback is good for liver complaints. When the patient is really unable to

walk, driving in an open carriage is preferable to a closed one; but some part of every day must be spent in the open air. The beneficial effects of exercise, golfing, tennis, cycling, gymnastics, cannot be estimated merely by the extra amount of oxygen inhaled, for it increases the activity of the skin and kidneys, and helps to unburden the liver by the removal of glycogen and the products of metabolic activity. Remedial measures should be taken at the same time; brisk purgation clears the bowels of bile and imperfectly digested food, relieves the congestion of the portal veins and liver, and stimulates absorption and bile formation. Nothing surpasses the alkaline or saline purgative waters for this purpose. The carbonate and chloride of soda and magnesia and phosphate of soda in these waters have a stimulant effect upon the biliary secretion, and the purgative action of the sulphates relieves venous congestion. Some of these salts enter the blood and are excreted by the kidneys, thereby promoting urea excretion and a ready means of relief to the liver. The alkaline carbonates will neutralize and conduct out of the body any excess of uric acid or other purin substance which may be the cause of gout, rheumatism, or gravel. The waters most suitable are those of Harrogate and Leamington in England; Carlsbad, Marienbad, Homburg, Kissingen, Tarasp, Vichy, Brides, on the Continent; while those of Hot Springs and the Saratoga-Vichy are good examples of American waters, and they may be taken for a long time without injury. If the nutrition of the patient has suffered very much, preference is to be given to those waters which contain small quantities of iron, as Harrogate, Leamington, Kissingen, Homburg, Rakoczy, Franzenbrunnen.

Spa treatment is excellent and useful, on account of the water which is drunk and the absence of business, freedom from worry, and distraction from introspection. Hydropathic treatment is useful in cases due to overeating or drinking; it usually consists of a douche of cold water applied to the region of the liver for about fifteen seconds daily, or a hot and cold douche alternately for similar periods, the whole application lasting only one minute. The patient stands with the right arm uplifted and the thigh advanced during the application. The constant wearing of a compress, consisting of a piece of spongio-piline wrung out of a

mixture of 2 ounces of dilute nitro-hydrochloric acid and a quart of water, over the region of the liver until it produces pimples, and a foot-bath of the same mixture for a few minutes every other day, are beneficial. Other counter-irritants can also be usefully applied over the liver—*e.g.*, chilli paste, mustard plaster, oil of mustard, iodine, and leeches.

In **cirrhosis of the liver** the treatment of the first stage, or hypertrophy, is practically that given above; but if once the second stage of the disease, characterized by contraction of the liver, sets in, nothing can cause the dense tissue to expand again, and our efforts must be directed towards relieving the concurrent catarrh of the stomach and bowels, and battling with the increasing emaciation and debility of the patient. The administration of the alkaline carbonates, as we have them in the natural waters of Vichy, Vals, or Apollinaris, will soothe the congested mucous membrane of the stomach and bowels, and decrease the tenacity of the mucus and assist in its removal. Hæmorrhage from the stomach and bowels is to be treated as stated under that head. Dropsy by *tapping* the abdomen when it is imperatively necessary to relieve the pressure. Unfortunately, as the latter symptom is dependent upon obstruction to the course of the blood through the liver, it is liable to return very quickly; careful and firm bandaging of the abdomen may afford some protection against its accumulation by giving some support to the organs and bloodvessels; but diuretic waters and drinks, both alkaline and alcoholic, are useless against it.

The regulation of the diet is the most important part of the treatment for improving the strength and nutrition. The diet should consist largely of eggs and milk, varied by thin oatmeal gruel, purée of vegetables or consommé, milk soup, oxtail soup, beef-tea, mutton or chicken broth; milk puddings, such as rice, sago, tapioca, vermicelli, macaroni, semolina, custard, junket, jelly, all sweetened with **saccharin or saxin**; also fish, chicken, pheasant, rabbit. It is better to avoid sweets and fat, and to reduce the amount of food to a minimum; indeed, a diet consisting chiefly of milk and eggs improves the nutrition, and often results in the removal of a large quantity of fluid from the swollen abdomen, which is materially aided by the natural sugar of milk or lactose. The dilution of milk is sometimes necessary

when patients find it hard to digest; buttermilk, whey, barley-water, Vichy, Vals, Ems, Apollinaris, or other alkaline waters may be used for this purpose.

GALL-STONES.

A gall-stone is a friable mass of cholesterin, lime, iron, and bile salts precipitated from the bile and bound together by an albuminous material, and is the result of concentration and vitiation of the bile. Catarrh or some other form of irritation of the mucous lining of the gall-bladder or of the bile-ducts causes an obstruction and consequent stagnation of the bile, which results in the deposition of materials which form the stones. The trouble is predisposed to by the consumption of a disproportionate amount of fat or other animal food; but the immediate causes are various, and include indigestion, high living, intemperance, worry, and indolence. Catarrh of the gall-bladder and bile-passages may likewise be due to the presence of micro-organisms, and obstruction of the passages may be produced by the pressure of a new growth—*e.g.*, cancer—upon the bile channels.[13] However it is produced, a stagnation of the bile is the first step in the production of the gall-stones. The signs are well known: repeated attacks of pain in the region of the gall-bladder, with vomiting and sometimes jaundice; sometimes there is a perceptible enlargement of the gall-bladder, or stones may be felt in it.

Treatment of an attack of 'biliary colic,' which is caused by the attempt to pass a gall-stone, consists of warm baths, poultices, fomentations, or mustard plasters, which are useful by relieving pain and relaxing spasm. Drinking large quantities of hot water, to each pint of which a teaspoonful of bicarbonate of soda has been added, acts as an internal fomentation, promotes the flow of bile, and thus urges the stone along the channel. The patient should persist in drinking this or other hot alkaline water until the paroxysm is passed, even though vomiting occurs.

To cure or prevent gall-stones the patient must be treated in the intervals of colic. We must cure the catarrh of the biliary channels, stimulate the muscular fibres and cells of the liver, relieve congestion of the veins, remove intestinal accumulations,

and stimulate intestinal activity. The alkaline waters of Bath, Apollinaris, Vichy, Ems, Vals, Carlsbad, Gerez, Brides, Marienbad, and others, which *contain very little lime*, cause a free flow of thin bile by which gall-stones are washed down. Immense quantities of gall-stones are evacuated with proportionately little difficulty by the Carlsbad and other waters. They also cure the catarrh of the bile-ducts and gall-bladder, stimulate the liver and intestinal glands, and relieve constipation. Spa treatment is very good, but not a *sine quâ non*, because many people do as well at home when they submit to proper treatment. Most of the Continental waters or their salts can be obtained for home treatment. Vichy and Carlsbad salts are always to be had. **Carlsbad salts** can be imitated by mixing together one part of common salt, three parts of bicarbonate of soda, and four parts of sulphate of soda. A teaspoonful should be taken in a tumblerful of hot water half an hour before each meal, the flavour being disguised if desirable by a little fruit syrup or orange juice. The patient should drink from 2 to 4 pints a day of water, either ordinary water (boiled to precipitate lime salts) or Apollinaris or Salutaris water (the latter being a pure distilled water, free from lime or other salts, obtainable 'still' or 'aerated'), in which the Carlsbad or Vichy salts can be taken. It is important to cure or prevent constipation, for which purpose the amount of sulphate of soda in the above mixture may be increased when necessary to insure two or three easy evacuations a day. Vichy water (Grand-Grille) and Saratoga-Vichy can be taken to the same extent, but are not aperient. **Vichy salts** can be imitated by mixing together 1 part of common salt, 1 part of bicarbonate of potash, and 6 parts of bicarbonate of soda, a teaspoonful being taken for a dose four or six times a day in plain or seltzer water, whey, buttermilk, or koumiss. If the patient be incommoded by so large a quantity to drink, a pint or more of warm alkaline water may be injected into the bowels and allowed to remain. A person who perspires freely during exercise should drink more than one who does not perspire readily.

Olive oil, castor oil, or glycerine in large doses will, if tolerated, be beneficial for gall-stones. The oils may be taken alone or with a little bicarbonate of soda, and glycerine can be drunk in Vichy or Apollinaris water.

The **diet** should neither be restricted in amount nor quality. An abundance of food promotes a flow of bile ; restriction of food diminishes it, with the further consequence that the secretion may remain in the gall-bladder instead of flowing into the intestines, where its stagnation favours the formation of gall-stones. Frequent meals are recommended, consisting of the ordinary and customary articles of food. Moderation is essential, excess to be avoided. Fat meat, sugar, and farinaceous foods should only be taken sparingly ; bread sparingly, and preferably as dry toast ; eggs may be eaten occasionally, but only one a day. Fruit and vegetables should be taken freely, especially green vegetables, salads, potatoes, and ripe fruit. They supply salts which become changed in the system into alkaline carbonates, and promote a flow of thin bile. Olives are good because of their aperient quality and richness in oil. Vegetable oils are not deleterious like animal fats, therefore salad oil is a useful article of diet.

The patient should *avoid* eating rich and greasy foods, much fat meat, butter, and excess of cane-sugar in any form. Especially avoid cheese, fat pork, duck, goose, high game, fried food, pickles, pastry, new bread, hot buttered toast, crumpets, suet puddings, spices, condiments, highly-seasoned dishes or sauces, indigestible fruit, and nuts. While green vegetables and fruits are highly recommended, those which are very sweet or contain much sugar should be avoided ; and peas and carrots contain a fatty substance, which is similar to cholesterin, and are to be avoided. Farinaceous foods also should not be eaten in excess, especially those which are sweetened.

Drink may consist of tea, coffee, cocoa made from the nibs, buttermilk, whey, koumiss, the alkaline waters, a small amount of Hock, Bordeaux, Moselle, or light Rhine wine, freely diluted with soda or seltzer water, Salutaris, Apollinaris, or other alkaline waters. But malt liquors, sweet wines, such as port or sherry, spirits, or liqueurs, ought to be avoided. A small quantity of dry champagne, when diluted with Apollinaris or other alkaline gaseous water, may be allowed, but not a sweet champagne.

The ordinary clothing may be worn, but it must be loose and warm; tight corsets or belts may obstruct the flow of bile and favour formation of gall-stones.

There must also be a change of habits. The sleep should be shortened to seven hours each night; a little walk should be taken before breakfast, and an hour or two of rest after the midday meal. The person whose occupation is sedentary, or confines him or her to the house, must go out more into the fresh air. Mental work should be reduced to permit of more exercise being taken in the form of walking, tennis, golf, cycling, horseback riding, or gymnastics. **Deep-breathing exercises** are a good means of unloading the portal circulation and preventing stagnation. The following are useful:

1. Stand in the erect position with the arms extended horizontally. Take a deep breath, and while doing so throw the head backwards as far as possible and twist the arms backwards. Return to the original position.

2. Stand with the arms at sides, relax the body so as to empty the chest completely. Then inhale deeply while drawing in the stomach, and throw the chest out to the utmost.

3. Stand erect, take a deep breath, and, while doing so, raise the arms above the head and clasp the hands; then bend forwards and downwards without bending the knees until the fingers touch the toes.

4. Lie flat on the back, stretch the body out well with the palms on the floor or bed. Take deep breaths.

5. Same position. Empty the chest completely; then, while taking a long and deep breath, raise the body into the sitting position, and bend forwards until the hands reach the feet. This should be done without assistance from the hands, the knees also being kept down.

Each exercise may be repeated from three to nine times, and care should be taken that the mouth is closed, and breathing only takes place through the nose.

6. While sitting or standing, clasp the hands in front of the abdomen, and take a full breath to expand the chest and depress the diaphragm fully, so that the liver gets a good squeeze between the diaphragm and the abdominal muscles.

Hydrotherapeutics.—A douche or stream of hot and cold water alternately applied to the region of the liver is sometimes valuable by stimulating contraction of the muscular fibres and the circulation. The nitro-hydrochloric compress may also be useful.

A plain water compress applied every night as follows is also serviceable: First put a hot fomentation over the liver and stomach for ten minutes; then wring a towel out of cold water, leaving it just wet enough not to drip, remove the fomentation, and apply the cold towel in its place; cover with a piece of oil-silk or mackintosh, and over that a thick flannel bandage to secure it in position and keep it moist all night. Remove it in the morning, sponge the part with cold water, carefully dry it, and wear a flannel bandage all day. A sitz-bath with massage may also be very useful. The patient sits in 4 or 6 inches of warm water, which is allowed to get cold, for a time varying from ten to sixty minutes, during which the abdomen is rubbed, kneaded, and massaged by the patient or attendant. It stimulates all the abdominal organs, the circulation, and nerves.

OBESITY, CORPULENCY.

Obesity, or abnormal increase of fat in the body, is essentially a condition of altered metabolism, allied to gout, diabetes, chlorosis, and myxœdema. In some persons the weight increases out of proportion to the consumption of food; in others it is the result of excessive eating and drinking, sedentary occupation, deficient oxidation, and similar causes. Corpulency is an affection which usually begins in middle life, when there is a natural tendency to embonpoint. The girth below the waist increases out of proportion to that of the rest of the body, owing to the deposition of fat in or around the abdominal organs and in the subcûtaneous tissues. The measure of corpulence is the excess in the circumference of the abdomen at the level of the umbilicus over that of the thorax.

The presence of superabundant fat in the tissues and organs greatly interferes with the discharge of their functions and produces discomfort. The elasticity of the heart muscle and energy of its contractions are impaired, whence the breathlessness on slight exertion which characterizes obese persons. Muscular activity is also diminished by a deposition of fat in the fibres. In the liver fat takes the place of protoplasm in the cells, and, owing to the mechanical impediment which its presence entails, the circulation through the liver and its glyco-

genic function are impaired or hindered. Briefly, the causes of abnormal increase of fat in the body are: (1) Eating and drinking in excess of the bodily requirements, even proteid food becoming fat when too much is consumed; (2) deficient oxidation and excretion. We derive from this several clear indications for treatment: (*a*) To remove the causes of metabolic deficiency; (*b*) to harmonize the proportion of food and drink with the output—*i.e.*, with the work performed and nitrogenous excretion; (*c*) to remove the ill-effects induced by the deposition of fat in the tissues and upon or within the various organs.

Obesity is largely dependent upon hereditary predisposition, on the mode of life, and not a little on the daily occupation. Fifty per cent. of cases are among persons who have a hereditary tendency to it. Dr. McLeod,[14] in an article on the 'Physical Requirements of the Public Services,' shows that there is a difference of a stone (14 pounds), both in the maximum, minimum, and average weight of men of twenty-five to thirty years of age, in the labouring and non-labouring classes respectively.

An important point in the treatment of this trouble is to gauge what may be called *the normal weight* of the individual. A person with a hereditary tendency to obesity must be content, if he wishes to remain healthy, to carry a certain amount of 'flesh'; and a person who daily drives to and from business, or has a sedentary occupation, must expect to carry more weight, and a professional man is usually heavier in proportion to his height than a labouring man, or one who walks and rides very much. The normal weight of a man does not consist of so many pounds of flesh to a foot of height, but is that weight which a person possesses when in moderate health, and it varies from day to day. It does not always agree with the standard weight given in text-books and affixed to weighing-machines, for it varies with the position in life as well as with the quantity and kind of work done. The normal weight of an individual may be difficult to ascertain, but it will usually be found in obesity to be about *the mean* between the standard and the actual weight of the person. Thus, suppose a person of 5 feet 1 inch to weigh 11 stone 10 pounds; a reference to various tables shows that the average or standard weight for a person of that height is 8 stone 8 pounds, by which it is assumed that he has excess of weight

amounting to 3 stones. The normal weight of such a person is probably *the mean* between the two—viz., 10 stone 3 pounds—and it will usually be found unjustifiable to reduce the weight in a greater proportion, for a reduction of more than that may cause irremediable damage to the health. It is necessary in all cases to break through the habit of beer-drinking, or eating fat meat, sweets, and starchy foods in excess. But it should not be forgotten that a very large number of people in middle life always put on flesh, owing to the reduction in physical activity, and perhaps to their getting into more comfortable and luxurious habits.

The diseases in which the reduction of excessive weight is an advantage are thus classified by Von Noorden:[15] Many cases of heart disease, chronic bronchitis, rheumatism, gout, diseases of the liver and kidneys. In diseases affecting the nervous and muscular apparatus fat is an unwelcome complication, and good results follow careful reduction. Nevertheless, every person who is overburdened with fat is not suitable for treatment; it should seldom be applied in cases of advanced organic disease, the aged, and children; and every case stands upon its merits, and should be carefully considered before the treatment is begun.

During treatment the digestive and excretory organs should receive proper attention to insure the assimilation of food and excretion of the waste products. Obese persons usually consume more food than they require to maintain their proper weight and supply heat and energy, and the balance, instead of being oxidized and got rid of, forms fat; this is particularly so with regard to saccharine and starchy materials. The regulation of the food is therefore one of the important parts of the treatment, and the consumption of food is usually reduced to a point at which the adipose tissue of the body must be drawn upon to supply by oxidation the necessary heat and energy for the body. This may be done by various dietaries.

1. **Starvation dietary**, such as the following, will effect reduction, but it is unscientific, barbarous, and unnecessary. *Breakfast*, a cup of tea or milk; *mid-day* meal, meat, with vegetables or salad, and 4 ounces of bread; third or *last meal*, a glass of hot milk, 2 or 3 ounces of bread, and a little fruit.

2. **Banting's dietary** is very similar to that used by 'athletes'

when in training, and is by no means to be despised as an anti-fat remedy. *Breakfast*, 4 or 5 ounces of beef, mutton, fish, cold game, or any meat except pork ; a little dry toast or biscuit ; about a pint of tea without sugar or milk. *Dinner* may consist of 6 or 8 ounces of any kind of fish except salmon, eel, or herring ; any lean meat except pork ; any kind of poultry or game ; any vegetables except potato, parsnip, carrot, or beet-root ; fruit out of a pudding or tart. Two or three glasses of sherry or claret are allowed, but no beer, porter, port wine, or champagne. *Tea* should consist of 3 ounces of fruit, a rusk or two, and a cup of tea without milk or sugar. *Supper*, 3 or 4 ounces of lean meat or fish, and a glass or two of claret. The total amount of meat is 15 ounces, and bread, toast, or rusk, 3 ounces a day.

3. **The Salisbury Treatment.**—*For rapid reduction* of weight Towers-Smith's modification of the Salisbury treatment is frequently used with marked success. Every visible particle of fat is removed from the food, thereby reducing the energy-producing material to about one-half the normal quantity, while the excess of proteid provokes an unusually rapid metabolism of all the tissues. The course is divided into three stages :

First stage—fourteen days : The daily food must consist of 3 pounds of rump beef steak, 1 pound of cod-fish, and 6 pints of hot water. These amounts are divided into parts for various meals. No bread, biscuit, toast, vegetable, or any other article is to be taken during this period. The meat may be roasted, baked, grilled, boiled, or steamed, and may be eaten whole or minced ; the fish is to be boiled or steamed. The only condiments allowed are salt, pepper, mustard, a little vinegar or chutney sauce. Each tumblerful of hot water may have in it a slice of lemon to give it flavour, or a little lime juice, which is credited with assisting the thinning process ; but no sugar, fruit-syrup, or alcohol. Active exercise must be taken ; the patient can usually bear six or seven miles walking per day in divided stages without undue fatigue.

Second stage—twenty-one days : The water may be reduced to 4 pints a day, and the food varied as follows : Any kind of meat free from fat may be eaten ; chicken, rabbit, or game ; and fish such as cod, haddock, halibut, turbot, skate, sole, plaice, or whiting ; no sauce can be allowed, but a little vinegar, pepper,

salt, ketchup, or anchovy can be used. A little green vegetable ought now to be taken, as cabbage, savoy, kale, spinach, lettuce, watercress, celery ; and a few slices of dry toast, unsweetened rusk, or Captain's biscuit may be permitted.

Third stage—twenty-one days : The hot water may be reduced to 3 pints a day, and that should be continued to the end of the treatment ; a little tea sweetened with saccharin or saxin may be allowed ; also a little Hock, Moselle, or claret, and seltzer or Apollinaris water ; but no sweet wines, malt liquor, spirits, or liqueurs. The food may consist of any kind of meat, game, poultry, or fish, free from fat ; any kind of vegetable free from sugar ; and dry toast, bottom crust or stale bread, and Captain's biscuit.

During the course the weight without clothing and the abdominal and thorax circumference should be measured and recorded once a week. The reduction of weight varies considerably, but usually averages 2 stones in three months. It is useless to undertake the treatment unless it is rigidly carried out ; the first two weeks are the only real hardship. But no person suffering from organic disease of any description ought to undergo reduction by such a rapid method of treatment, as their disease may be aggravated thereby.

4. **Slow reduction** permits of a much more varied diet, and the following articles of food *may be allowed :*

Soups.—All *clear* soups (excepting those which contain vermicelli, macaroni, rice, barley, oats) : julienne, kidney, ox-tail, fowl, game, fish, oyster, lobster, and tomato soups.

Fish.—Sole, plaice, smelts, whiting, haddock, brill, turbot, flounder, cod, ling, halibut, white-fish, salmon, trout, perch, bream, oysters.

Meat.—All kinds of *lean* meat not cooked with fat : mutton, lamb, beef, beef steak, veal, sweet-bread, kidney, chicken, pheasant, pigeon, guinea-fowl, turkey, partridge, hare, rabbit, leveret, lean ham, tongue, eggs, cheese, and new milk-cheese.

Sauces may be made of apple, onion, gooseberry, horse-radish, cucumber, lemon, mint, tomato, spinach, or mushroom.

Dry toast, stale **bread,** bottom **crust, gluten bread, almond bread,** and **Captain's biscuits,** are allowed in moderation.

Cooked Vegetables.—Cabbage, savoy, kale, brussels-sprouts,

cabbage sprouts, cauliflower, broccoli, seakale, red cabbage, spinach, artichokes, cardoons, vegetable marrow, pumpkin, green peas, kidney beans, turnips, *new* potatoes, stewed celery, stewed cucumber, leeks, Spanish onions, tomatoes, and mushrooms.

Salads.—Lettuce, watercress, celery, mustard and cress, onions, tomatoes, and cucumber.

Dessert.—Nuts and most kinds of fruits (except sweet ones); stewed apples, pears, plums, damsons, cherries, rhubarb, raspberries, strawberries; apple-snow, compôte of apricot, prunes, damsons, or plums; damson cream, raspberry cream, rhubarb mould; calf's foot and other jellies; and puddings of gluten flour, vermicelli, or macaroni. All the above may be sweetened with saxin or saccharin, but no sugar must be used.

Drink.—Plain water is not fattening, and may be taken *ad libitum.* The total amount of drink should not exceed 2 *pints a day.* It may consist of water, tea, coffee, or cocoa made from the nibs; Vichy, Vals, Apollinaris, Salutaris, Saratoga, Vichy, or seltzer water; lemonade, lime-juice, and apple-water, sweetened with saccharin; a little Hock, Chablis, sherry, claret, Moselle; also claret-, Moselle-, or champagne-cup, and brandy or other spirit well diluted.

Ebstein's dietary is one frequently prescribed; it is as follows: *Breakfast:* A thick slice of bread-and-butter and a large cup of tea. *Dinner:* $\frac{1}{4}$ pint of clear soup, 5 ounces of cooked meat with green vegetable, and $\frac{1}{2}$ pint of light wine. *Tea:* The same as for breakfast. *Supper:* An egg, 3 or 4 ounces of cooked meat, half a slice of bread-and-butter, a small piece of cheese, some fruit and tea. It is to be observed that there is no restriction of fat, and sauces are allowed. It includes $3\frac{1}{2}$ ounces of *dry* proteid, 3 ounces of fat, $1\frac{3}{4}$ ounces of dry carbohydrate, 3 pints of liquids, and yields 1,300 calories. Oertel restricts the consumption of fat and liquids. He allows a diet containing $5\frac{1}{2}$ to $6\frac{1}{2}$ ounces of dry proteid, 1 to $1\frac{1}{2}$ ounces of fat, $2\frac{1}{2}$ to $3\frac{1}{2}$ ounces of carbohydrate, and 1 to $1\frac{1}{2}$ pints of liquid daily, which yields 1,200 to 1,600 calories. The normal diet considered necessary for a man doing ordinary work includes food containing $4\frac{1}{2}$ ounces of proteid, $3\frac{1}{2}$ ounces of fat, 14 ounces of carbohydrate, 3 to 4 pints of liquids, and yields about 3,000 calories. The chief difference in the dietary allowed for obese or corpulent persons is in the reduction

of the fat and carbohydrate; in other words, a restriction of the sugar, starch, and fat contained in the bread, pastry, butter, fat meat, and sweetened dishes, which are excluded. This list is amplified as follows:

May not have sugar and fat in any form, and the carbohydrate must be reduced; hence *avoid* all rich, fat, or sweetened dishes (except with saccharin); sugar, jam, marmalade, preserves, honey, treacle, confectionery; bread (except a small quantity), rice, sago, tapioca, arrowroot, cornflour, blanc-mange, oatmeal, maize, pastry, boiled puddings; potatoes (except new ones, which contain much less starch than ripe tubers), carrots, parsnips, swede-turnips, beet-root, asparagus, dried peas and beans, and artichokes in very strict dieting; thick soups, milk, ale, stout, port wine, home-made wine, syrups, and sweet drinks of all kinds; cream, cream-cheese, rich and ripe cheese, thick cocoa; herrings, mackerel, eels, and other fish rich in fat, sardines and pilchards done in oil; pork, duck, goose, liver, and any food cooked in fat or oil; olives, grapes, raisins, currants, figs, dates, candied fruit, sweet apples or pears, mulberries, and all other sweet fruit.

5. **Treatment by dry diet**—that is, without drinking with the food—is very good if it can be tolerated. It has the support of Oertel,[16] Grocco,[17] Balfour[18] and other specialists, in certain cases. But it is liable to cause gastro-intestinal disturbances, gout, gravel, renal colic, or neurasthenia. It is a useful method of treatment for those who habitually drink too much. It can be ascertained if harm or good is resulting from the treatment. Thus, it is probably doing good if the secretion of urine is not diminished in quantity; but it is doing harm if the urine becomes scanty and acid, and the perspiration is checked or digestion disturbed, because it is then interfering with assimilation and excretion. The beneficial effect of the reduction of or abstention from fluid is quite empirical. In cases where an absolutely dry diet cannot be borne the patient should abstain from drinking at meal-times, but have a draught of any suitable liquid about two hours afterwards, water being the best. It is sometimes beneficial if the total consumption of liquid is reduced to 15 ounces daily—viz., a cupful of tea at breakfast, a cupful of tea at tea-time, half a glass of wine after the mid-day meal, and

a little spirit in 3 or 4 ounces of water, or a glassful of hot water alone at bedtime, whereby we have a modified dry diet.

Different patients require different methods of treatment; one mode is not suitable for all persons. It is impossible to arrange a dietary which will agree with everybody; the state of health, habits, and convenience must be considered in each case. In the majority of instances the reduction of weight should be gradual, and the reduction of food and drink should not be suddenly brought about. Rapid reduction of weight, which is readily effected by the Salisbury treatment, is worse than useless if it is followed by a season of indulgence. With most people a reduction of 1 kilo (about 2 pounds) per week is the best; and less than that, $\frac{3}{4}$ to 1 pound per week, is advisable in persons afflicted by disease. The food should be such as will not leave a sense of hunger, but rather of satisfaction and well-being. The consumption of proteids should be especially watched, and regulated according to the needs of the body. In no case ought the amount of proteid to sink below that which will supply the nitrogen excreted; for which reason Grocco and others recommend regular and frequent examinations of the urine and estimation of the urea output. The excretion of nitrogen by the kidneys is probably not more than 90 per cent. of that in the food. The amount of nitrogenous food consumed should vary with the excretion of this material just as much as with the health, habits, and circumstances of the patient. The reduction of food is not the only principle to be observed in the treatment of obesity. In very many cases there must be a rearrangement of the habits, and perhaps of the occupation or method of performing it. The sedentary man must take more exercise in the form of walking, golfing, tennis, cycling, horse-riding, rowing, swimming, and gymnastics. Mental distraction by change of air and scenery is good for some people, especially when it is combined with walking and climbing. Early rising is better than late hours. Seven hours' sleep should be the limited amount. Unlimited sleep and a warm bed favour obesity. The body should be lightly clad, the clothing being of sufficient warmth to keep the skin in action, but not heavy enough to prevent the dispersion of heat from the body.

As regards gymnastics, the ordinary course at a gymnasium is

very good, but all exercises which will strengthen the abdominal muscles and stimulate the circulation are useful. The abdominal muscles are very little used, except through the influence of the will. Defective action weakens them, and when this is combined with congestion of the abdominal veins and deficiency of oxygenation, it leads to corpulency. When, however, these muscles are persistently and intelligently exercised, they may be made a means of stimulating the portal circulation and reducing corpulency. The following exercises are simple, and can be performed by most people, excepting those who have a disease of the heart. The latter may perform the Schott exercises (see 'Heart Disease').

(1) Lie flat upon the back; raise the body several times into a sitting posture without the aid of the hands, and bend forwards.

(2) Lie upon the back; draw up both knees to the abdomen, clasp them with the hands, and press them well against the body. When the patient is well used to this, it may be varied by doing it while standing, each knee being drawn up in turn and pressed to the abdomen.

(3) Clasp the hands across the abdomen, inhale, and bend backwards and forwards several times to the fullest extent.

(4) The deep breathing exercises (as mentioned for gall-stones), the hands clasped in front of the abdomen (*a*) while sitting, (*b*) standing, inspiration and expiration being as full as possible.

(5) The muscles of the back should be exercised (*a*) by movements imitating rowing and canoeing; (*b*) stand erect, bend the body to the ground as if trying to reach the toes with the outstretched hands, resume the exact attitude, using the hip-joints as a hinge; (*c*) by spiral and sideway bending movements, in each of which the knees and hips are kept straight and still.

The exercises should last twenty to thirty minutes each day. Each movement should be performed evenly and a given number of times. An ordinary full course of gymnastics, like that for muscular development, may be taken by those who are sound. It has the advantage of removing fat from the parts exercised (see 'Exercise in Gout').

Spa treatment at Marienbad, Carlsbad, Nauheim, Vichy, Contrexéville, Bath, Harrogate, Buxton, Hot Springs, and many other places which are recommended for the treatment of gout

and liver diseases, has a beneficial effect upon obesity. All alkaline waters, especially the chloride, sulphate, and ferruginous, are suitable for it, and may be drunk at home as well as at the spa. Promoting the eliminatory functions by saline aperient waters, such as Hunyadi Janos, likewise stimulates the abdominal circulation, and is a valuable aid to other treatment in these cases. For home treatment let half or a third of a tumbler of such a water be taken every morning on rising; it will stimulate metabolism and the elimination of waste products, get rid of unassimilated nutriment, cause oxidation of the remainder, and prevent its formation into fat. By stimulating the portal circulation it will relieve the congestion of these vessels, deplete the body of fluids, and enable the liver to discharge its various functions more thoroughly. Those who go to a spa to drink the waters, but do not reform their habits, will probably find that their weight is increasing instead of diminishing, for change of air and water materially stimulates the appetite and digestion.

Baths of alkaline, brine, or sea water are beneficial in obesity. Kellog[19] considers swimming and bathing to be two of the most efficient means of reducing weight. He says a cold bath lasting ninety-eight minutes is equivalent to a twenty miles walk for reducing flesh. We certainly have in bathing an effective means of abstracting heat from the body, and thereby causing an increased oxidation of the tissues. Physiologically only one-fifth of the heat produced in the body by oxidation of the food and tissues is used for work, the remaining four-fifths for warmth, and it escapes from the surface of the body by evaporation, radiation, and convection. Immersion in cold or nearly cold water, to which heat is readily conveyed from the body, will therefore cause a greater expenditure of heat, and a greater consumption of material to produce it. The combination of exercise and abstraction of heat which takes place by swimming in cool water (68° to 75° F.) will, when joined to a modification of the diet, certainly cause a reduction of the flesh. It is not everybody who can bear prolonged immersion in water, even when it is combined with the exercise of swimming, because their power of reaction is low, or not sufficiently responsive to cause a glow on the skin, and they therefore become blue and chilly, and may have cramp. Such people are not proper persons for this mode of treatment.

Turkish baths, which consist of air heated to 180° or 200° F., are powerfully diaphoretic, and are useful for obesity by producing a free action of the skin and stimulating metabolism. The Russian or vapour bath is likewise a powerful diaphoretic, and causes reduction of weight by removing a large quantity of water from the tissues. In both cases the body should be cooled by sitting in a room of a lower temperature for some time before exposure to the outside air.

Massage.—General massage does not reduce fat, but rather increases it where used alone ; but in combination with Turkish and other baths it stimulates metabolism and assists in absorption. Local massage of the abdomen is a valuable adjunct to other treatment, for it stimulates the portal circulation, reduces congestion of the abdominal organs, and promotes the absorption of superabundant fat.

The inhalation of **oxygen** is useful if it is steadily persevered in for cases attended by great feebleness due to organic disease. It is impossible to insist upon a very modified diet and much exercise in the class of cases referred to.

Slow methods of treating obesity always produce the most permanent results—say the reduction of a pound a week for three or four months. The cure is not complete until the patient is relieved of the superabundant fat, and has settled down to a mode of living and a dietary which will not increase weight. Success depends largely upon the stage at which the treatment is begun ; it is best when started early, and in all cases the greatest care must be taken to avoid injury to the heart and nervous system.

The *consequences* of an increase of adipose tissue are not only unpleasant : they are deleterious when the muscles, liver, and other organs become infiltrated by fat, and their action is enfeebled or functions defective. Among these consequences we must include **fatty heart**. By this term is not meant a metamorphosis of the muscular fibres into fat, but an overgrowth of fat upon the surface of the heart, which by its pressure upon the muscular fibres causes them to waste to some extent, and otherwise overburdens this organ. The heart is enfeebled, the pulse thin and weak, there is sometimes faintness, and breathlessness occurs on the slightest exertion, such as ascending a staircase or

a little hill, and even when walking on a level. An examination of the heart reveals no sign of diseased valves, but the sounds are faint and the impulse diminished. Such a person should reduce his weight by avoiding excesses in eating and drinking, and perhaps by adopting a *dry diet;*[18] by rejecting alcoholic beverages, tea, coffee, aerated waters, and other sweet drinks, and tobacco; by taking the exercises designed by Schott, or by a course of the alkaline waters.

Arterial changes or degeneration are frequently associated with obesity and excessive eating and drinking, combined with other luxurious habits. When this occurs there is a pulse of high tension, thickening and elongation of the arteries, and possibly an enlargement of the heart. There is a risk of apoplexy, degeneration of the brain, degeneration of the substance of the heart, and angina pectoris; kidney disease is also a not infrequent consequence. These changes are due to a pathological disturbance of the metabolism, whereby there is induced an increase of the peripheral resistance to the circulation. An increase of the arterial and cardiac pressure follows, and results in a degeneration of the bloodvessels and enlargement of the heart; heart failure often occurs, with shortness of breath, slight swelling of the ankles, and venous congestion of the liver.[20] These changes may occur in all old people, but are very common in women of middle life and stout persons of advancing age. The treatment consists in regulating the diet according to the age and other circumstances: (*a*) In middle age it should consist of meat and vegetables, while the sugars, starches, and alcohol must be avoided.[21] (*b*) In advanced age animal food, even eggs, should be eaten sparingly, and milk with farinaceous materials, fruit, and vegetables, ought to form the chief elements, but the diet must be limited to the daily requirements. The patients should take no fluid with their food, but may drink afterwards. They must keep their bowels rather loose, avoid extremes of heat and cold, and excitement. They should take regular exercise in the open air short of fatigue, and avoid violent exercise of any kind, but the Schott exercises are beneficial (see also 'Dietary in Old Age'). Residence in a genial, sunny climate is best for the winter, and a cool, bracing climate for the summer. The alkaline waters are sometimes very useful. Hot baths must be avoided,

but warm baths, followed by massage or friction to the back and limbs with a rough towel, are advisable. Such patients should be taught the danger of luxurious living, but with careful living and dietary the risks will be diminished and the general condition will improve.

GOUT.

The gouty diathesis depends upon a defect of metabolism whereby some of the nitrogenous substances, which should be transformed into urea and leave the body in that form, become converted into **uric acid**. As long as the excess of uric acid is regularly excreted by the kidneys, the affected persons get on very well and have no trouble. But if the uric acid be produced in excess of the amount which the kidneys can deal with, it will probably be deposited in the tissues and the joints, and an attack of gout ensue. If the secretion of the urine is impeded in any way, such as by the kidneys becoming blocked by uric acid or its compounds deposited in the tubules, an attack of gout will ensue. If the deposit of urates in the tubules of the kidneys be soon washed away and a red sandy deposit appear in the urine, the attack of gout may pass over without leaving any special marks of its occurrence. But if the kidneys should continue to be irritated by an excess of uric acid or urates, there might be developed what is known as gouty kidneys and other evidences of chronic gout. That uric acid or urate of soda is present in gouty kidneys has been repeatedly shown, yellowish-white streaks in the kidney substance revealing its situation. That the same substances are deposited in the joints inflamed by gout has been clearly proved by examination of such joints after death, when the cartilage has been found covered with a bright white incrustation, and a microscopic examination of sections exhibited the minute crystals of these materials in the cartilage, ligaments, and other tissues. That these deposits arise from interference with excretion by the kidneys, causing a rise in the amount of uric acid and urates in the blood and system, was proved by Hoppe-Seyler,[20] who tied the ureters of geese and chickens and killed them a few days after the operation, when he found the surfaces of the joints and various organs incrusted with such crystals.

All authorities are agreed that uric acid is an essential factor in producing gout. An excess of uric acid in the form of quadurate or biurate of soda is found in the blood of all gouty persons, and this is accepted as the great factor in all gouty manifestations. Now, uric acid is the product in man of the incomplete oxidation of nitrogenous waste materials in the food or body. The liver is the great urea-producing organ, but uric acid is formed in other organs and cellular tissues from nuclein and purin bodies. Whatever the source of uric acid, it accumulates in the system from one of the following causes: (1) Diminished excretion or elimination; (2) increased production. Probably both factors play an important part. Increased production results in an irritation of the kidneys, which consequently lose their power of elimination; a vicious circle is formed, overproduction resulting in diminished excretion.[21] There is always a deficiency in the amount of uric acid excreted immediately preceding an attack of gout, and an increase in the quantity as it passes off.

We have seen that defective action of the liver results in a deficient oxidation of certain metabolic products and failure to transform them into urea, which is the proper form in which nitrogen is excreted from the body in man. Failure of the liver to transform them into urea is a cause of excessive production of uric acid,[22] and failure of the kidneys to excrete the uric acid so produced is a further cause of its accumulation in the system.[23] Quadurate of sodium is the form in which uric acid is normally present in the blood up to a certain degree (Roberts), and the consumption of vegetables which are rich in salts prevents the decomposition of this material, and assists in its removal from the body. But when it is produced in excess, or it accumulates because its elimination is diminished, it unites with the carbonate of soda in the blood and forms **biurate of sodium.** The latter is neither very soluble nor readily excreted by the kidneys, and its insolubility is increased by the salts of meat, the consumption of which renders its deposition in the joints and tissues very probable.

A hereditary tendency to gout is the most important factor in its immediate causation, and is known to exist in about half the cases; then, the other conditions existing, a slight exciting cause

will produce the disease. It does not often occur in childhood, is more common in men than women, and usually begins after thirty years of age. Next to hereditary predisposition, the cause is most commonly associated with the diet. Although it sometimes occurs among the poor, it exists chiefly among the well-to-do or those in comfortable circumstances, who are given to the pleasures of the table and take very little exercise. Eating large quantities of meat, game, and other flesh or fish, especially when combined with the consumption of alcoholic liquors, particularly malt liquors, port wine, or sherry, contributes to that condition in which a larger amount of uric acid is formed than the system can eliminate, there not being consumed sufficient oxygen to convert all these materials into urea. Various occupations may predispose to it, as those which cause a sedentary life, or which tempt to the consumption of meat or alcohol in excess. Lead-poisoning even in a slight degree amongst painters, plumbers, type-founders, and others, also predisposes to it; and worry, distress, or injury may induce an attack in a person who is predisposed to it.

An attack of gout usually causes an inflammation of the joint of one big toe. It is frequently preceded for a short time by unusually good health, robustness, or exhilaration, but in some persons by mental depression, disturbed sleep, ringing in the ears, cramp in the limbs, itching of the skin, and other signs of disturbed health. After these premonitions have lasted a few days, the patient wakes in the night with an excruciating pain in the toe, which is swollen, tense, shining, and excessively tender. When the pain and fever pass off the patient may be in better health than formerly, his system being somewhat cleared by the attack; but other attacks may occur at intervals of months or years. The intervals tend to lessen. Other joints become affected in succession, as the opposite ankle, a shoulder or hip joint, and the small joints of the hands and feet. The swelling about the joints may be increased by white deposits, called **tophi** or chalk stones, by which deformity is produced. The stage of chronic gout is now reached.

Besides the regular or ordinary gout, there is an irregular or abarticular gout, which affects various organs and tissues, producing gout in the stomach, gouty kidneys, gouty heart, gouty eczema, and degenerations of the bloodvessels. Gout may affect many

tissues in a smaller degree than the joints. Few people over forty have not suffered from what they call 'rheumatism,' by which they mean aches and pains affecting muscles, tendons, and nerves, which should properly be called abarticular gout, because the responsible cause is uric acid, alone or in combination, floating in the blood. The acid, being deposited in the fibrous tissues of the affected parts, irritates the nerve-endings in the same way as any other foreign substance. People who suffer from this usually have a brick-dust sediment in their urine, a tired, weary feeling, headache, mental torpor, irritability, or 'fits of the blues.' The pains are of a shifting character, and nervous people suffer most severely. Pains in the loins, 'crick in the back,' cramp in the legs and feet, aggravated by cold and damp, often attributed to twists and sprains or 'rheumatism,' are really caused by diminished excretion or increased production of uric acid.

The Treatment of Gout.—1. During an attack of *acute gout* the patient should rest on a bed or couch. The diet should consist of 4 or 5 pints of milk in twenty-four hours, which may be diluted with or given alternately with pure or alkaline waters, ordinary soda, lithia, or potash water. The joint should be wrapped in lint saturated with a strong solution of bicarbonate of soda, over which is placed a thick layer of cotton-wool, and the entire foot enveloped in a silk handkerchief.

2. *Chronic Gout, Articular and Abarticular.*—If the patient's health is bad, we should not use a lowering régime, but allow a rather liberal diet of milk, eggs, oysters, chicken, pheasant, game, mutton, fish, an abundance of green vegetables, potatoes, or salads, and milk puddings. Undoubtedly a *purin-free diet* is the best, such as milk, cream, eggs, butter, and cheese; but it is impossible to confine the patient to this for a long time, and we must soon allow a little fish or chicken, some dry toast, fresh green vegetables, potato, and rice pudding. The patient should avoid the articles named below.

3. *The Prevention of Gout and Treatment of the Gouty Diathesis or Constitution.*—*Forbid* an excess of meat, fish, game, and all kinds of animal food, and *all* rich foods—pork, veal, sausage, duck, goose, salted or dried fish or meat (except fat bacon and ham). Fish, like other animal food, should be eaten sparingly; oysters, lobster, crab, and other shell-fish, and fish which is rich

in fat, as mackerel, herrings, mullet, eels, and salmon, are better avoided altogether. Also avoid rich soups, gravy, sauces, extracts of meats, entrées, hashes, and other made dishes; food fried in fat, spices, pastry, rich puddings, pickles, vinegar, rhubarb, lemons, mushrooms, asparagus, dried peas and beans, tea and coffee, and all sweet foods.

Great moderation in the consumption of fat, as well as saccharine and gelatinous foods, is necessary. They tend to produce uricacidæmia by preventing the complete metabolism of proteids, and encourage an accumulation of waste matters. There is, however, no reason for withholding fat from a thin person, and Ebstein allows it in all cases, because it quickly satisfies the appetite and reduces the consumption of carbohydrate and other food.[24] Eggs are tabooed because of the lecithin they contain and the excessive amount of fat in the yolk; but the white of eggs is permissible, and even the whole egg in cases where fat is not entirely forbidden. Lecithin and nucleo-proteids exist to some extent in the legumes, for which reason peas and beans are forbidden.

Most vegetables are valuable and allowed, but mushrooms, truffles, and morels are forbidden. Tomatoes, spinach, sorrel, and asparagus are condemned because they contain oxalic acid (or its salts), which is a congener of uric acid. Very sweet fruits, whether fresh or dried, are unsuitable, because of the sugar they contain.

All sweet wines, as port, sherry, Madeira, Marsala, Burgundy, strong claret, or sweet champagne, should be avoided, as well as ale, beer, stout, and porter. There are differences of opinion about cider: it contains malic acid in combination with potash, and is held by some authorities to favour the formation of uric acid, for which reason they prohibit it; but others consider sparkling dry cider to be a useful diuretic, and to favour the expulsion of uric acid.

Allow: **Clear soup**, vegetable broth, julienne, oyster, kidney, fish, or game soup. **Fish**: All the lighter kinds, as boiled sole, plaice, whiting, turbot, brill, flounder, cod, and fresh haddock. **Meat**: A little chicken, rabbit, pheasant, partridge, turkey, or mutton only once a day and in moderate quantity. **Vegetables** may be eaten abundantly, especially cabbage, savoy, brussels-

sprouts, cabbage sprouts, cauliflower, vegetable marrow or squash, *green* peas or kidney beans, and a *little* mashed potato; lettuce, celery, endive, cucumber, watercress, mustard and cress; most ripe fruits, raw or cooked, especially apples. **Carbohydrate** may consist of stale bread, dry toast, rolls, crackers, zwiebach, oatmeal; rice, sago, tapioca, vermicelli, macaroni, semolina, in the form of milk puddings; also custard, junket, and blanc-mange. Stewed fruit and other articles should be sweetened with saccharin or saxin, *not with sugar.*

Drink should be taken to the extent of 3 or 4 pints a day; it may consist of pure water, one of the alkaline waters, China tea, a *little* light claret, Hock, Moselle, dry sherry, or well-diluted spirit. Milk is easily digested by most people, and may be taken alone or combined with an alkaline water. Alcohol is the worst enemy of the gouty, because it decreases the excretion of uric acid and checks the functions of the liver. Water is the best friend, because it is a solvent of uric acid and the urates, and removes all kinds of waste material by flushing the system. Pure distilled water possesses this faculty in a remarkable degree, and is sold under various names, both still and aerated being put up in bottles for household use. **Bath sulis water** is a suitable alkaline water, and so is Apollinaris and many other of the alkaline natural waters.

A gouty person should only eat three times a day, but a cup or two of tea may be taken about 5 p.m. Sobriety should never be departed from. Alcohol should be taken exceedingly sparingly or avoided altogether; water should be drunk freely; sugar should be replaced by saccharin: salad oil may be used in salads in place of vinegar; and pickles and spices should be avoided. An open-air life should be led as far as possible to encourage metabolism, and care should be taken to avoid protracted mental or physical effort, which sometimes precipitates an attack.

It is better for the form, quantity, and quality of the food to be stated; indeed, the gouty person requires to be taught what and how much he may eat, because, although he may break rules readily enough, he will do so less often than if he had ignorance as an excuse for his errors. He should be forbidden 'to dine out,' even if he promises to be very moderate. The use of beer and wine retards tissue transformation by reducing oxidation,

and so are very injurious to the gouty; besides, patients eat less when they do not drink with their food. Persons inclined to the production of fat will, under the influence of beer or wine, become very obese, have a red face and distended veins; the functions of their liver and stomach become impaired, and gouty effects follow. This consideration, as well as the fact that persons who drink neither wine nor beer are seldom gouty, should induce us to forbid their use altogether by these persons, or to have them stopped gradually. The fact that more food is eaten by persons who drink freely while eating suggests the propriety of their eating without drinking at all; this would insure the more careful mastication of their food, and the liquids they drink may be taken before or after their meals.

Coffee, tea, and cocoa are very active in causing uric acid and other purins to be formed within the body. The production and elimination of the 'purins' has been increased as much as 125 per cent. by drinking coffee. This we cannot be surprised at when we consider that caffeine is trimethylxanthin, and theobromine is dimethylxanthin, and belong to the group of purins which are transformed into uric acid. These liquids should therefore be excluded, or only allowed in very small quantity in the diet of the gouty.

We should also exclude meat extracts, meat juice, rich gravy, strong soups, beef-tea, liver, sweet-bread, milt (spleen), brain, and fish roe. These foods are rich in the purin bodies which are readily converted into uric acid, and the output of purin is speedily increased 100 or 150 per cent. by their consumption. Dried meat, such as tongue or ham, can sometimes be eaten with impunity by gouty patients without increasing the purin output, but with increase of bodily strength and power, because there is a partial loss of the meat juices involved in the process of curing and drying. It has been previously observed that purins are derived from the nucleo-proteids of nitrogenous food, where they are combined with albumin in the cell nucleus and are called 'nucleins'; but they exist uncombined in the meat juices and extracts, and are therefore ready for speedy transformation into uric acid. Some animal products are entirely free from 'purins,' as milk, cream, new milk cheese, cream cheese, cheese, eggs, and butter, and these substances eaten with bread form

practically a *purin-free diet.* Nuclein exists in great abundance in vegetable tissues, especially in seeds like the pulses, peas, beans, lentils; we should therefore exclude dried peas, beans, haricot beans, lentils, asparagus, mushrooms, and other vegetables known to be rich in nuclein or purin bodies. Most green vegetables and salads are rich in salts which are valuable to the gouty, and *may be eaten freely.* Purins are injurious in every way; this has been proved by experiments upon animals fed with them. A small daily dose, extending over several months, causes, in the lower animals, similar diseases of the liver and bloodvessels, and important changes in the cellular tissues, to those which occur in human beings.

The value to gouty people of drinking daily a large quantity of water is due to the fact that the water contains nothing which would lessen the metabolism of the tissues by being itself consumed. It does not cause a less need for food, and fatigue is not better borne because of its consumption. It does not cause a red face, indigestion, liver complaint, and corpulence; on the other hand, it hastens the metabolism of the tissues, washes the waste materials out of them, stimulates the secretion of the liver, kidneys, and skin, and is thereby as valuable to gouty people as tea, coffee, beef-tea, beer, wine, and spirits are injurious.

The value of the alkaline salts in gout is rendered visible during 'a course of the waters,' containing carbonates and chlorides, at Vichy, Contrexéville, Marienbad, Baden, Carlsbad, Homburg, Kissingen, Neuenahr, Eger, Wildbad, Wiesbaden, and at Hot Springs and other spas in America. Their beneficial effect exceeds that of ordinary water; they reduce plethora, promote the metabolism of the tissues, remove waste products, and assist in their elimination. Opinion seems to be in favour of those which contain the most chloride of sodium, like the Kissingen and Homburg-Elizabeth waters, as being more beneficial for gout than those in which there is more bicarbonate and less chloride. The water of Woodhall Spa contains a large proportion of chlorides in addition to salts of iodine and bromine, that of Buxton has chloride and other salts of calcium; both are held in high repute for the treatment of gout in its various forms. They act very largely by diluting the blood and urine, by dissolving the uric acid salts out of the tissues, by thinning the bile and

stimulating the urea-producing function of the liver, and by washing the kidney tubules free of retained urates. The primary effect of some mineral waters—*e.g.*, those containing sulphates—is to precipitate an attack of gout by rendering the uric acid insoluble ; but when this attack has passed off, the blood is freed from urates, and a continuance of the water stimulates nutrition and metabolism throughout the body, and the blood is kept clear from urates for a considerable time.

Exercise.—By no means must we allow the patient to give himself up to sluggish ease, but we must see that he exercises himself as much as his strength will allow. Muscular activity hastens metabolism and the elimination of waste materials, but a lazy and easy life does the opposite, and is bad for gouty persons. It is objected to this by some writers that exercise increases perspiration, but diminishes the excretion of urine; that draining of the tissues and concentrating the urine prevents the ready removal of waste materials and encourages gouty or uratic deposits. To which it may be replied that if the patient drinks plenty of water and other liquids there will be ample fluid in the system to supply perspiration as well as urine. *The effects of exercise* are as follows :

1. The action of the heart is increased in force and frequency; the breathing is deeper and more rapid.

2. More blood is driven through the lungs, and it is better purified ; more oxygen is inhaled, more carbonic acid and water exhaled.

3. The circulation through the peripheral vessels is increased ; the small arteries, capillaries, and lymph spaces dilate; the sweat glands are stimulated, perspiration is free, and the radiation of heat from the body is accelerated.

4. A simultaneous decrease in the amount of urine occurs, owing to the increased loss of water through the skin (*this objection is replied to above*). The excretion of urea, uric acid, and other nitrogenous matters, is not lessened, but may be increased,[25] because the perspiration is comparable to dilute urine.

5. The muscular system is brought into active work, whereby the blood-supply to the muscles is increased, the circulation accelerated, their waste materials more rapidly carried away, and new material brought to them. When the subject is in a poor

condition there may be a rise of uric acid, extractives, and phosphoric acid, but this does not occur under normal conditions.[25]

It has been estimated that a walk of sixteen miles at the rate of three miles an hour by a man weighing 160 pounds involves the expenditure of energy equal to 300 foot-tons, and is as much as an average day's work.[26]

Regular exercise in the open air increases combustion, radiation of heat, excretion of water and waste materials, and purifies the blood. It creates appetite, causes the circulation through the muscles to be more rapid, whereby more nutriment is brought to them and débris removed; it hardens, enlarges, and strengthens the muscles.

Excessive exercise or muscular work causes breathlessness and palpitation; the pulse becomes small, the heart quick and irregular; sufficient time is not allowed the heart for its proper pause or period of rest. In consequence the heart becomes enfeebled, and has to contract more often to do the same amount of work, which may lead to dilatation or hypertrophy. The muscles of the body also require rest to get rid of the accumulated waste products resulting from their activity and take in more oxygen; without periods of rest all muscles become exhausted, their contractions enfeebled, and debility induced.

In gouty persons indigestion or catarrh of the stomach must be treated. Dyspepsia is a common trouble. Sometimes the gouty person cannot assimilate the ordinary foods because his digestive organs are diseased, and not because he abuses 'the pleasures of the table.' There is abnormal fermentation in the alimentary canal, and deficient oxidation in the blood and tissues. Substances containing nuclein or purin are not properly oxidized into urea, but are transformed into uric acid. Meanwhile the uric acid, instead of being destroyed, as usual, is being further manufactured in the body by the chemical combination of glycin and urea. It is, therefore, chiefly by attention to the organs of digestion and assimilation, especially those which hasten the end of metabolism and cause the removal of their products, by the means detailed above, that we may hope to cure gout or alleviate very bad cases.

CHRONIC RHEUMATISM.

The effects of cold and damp upon people with a gouty tendency is to cause pain in the muscles, fibrous coverings, tendons, and tissues about the joints. Sir W. Gowers[27] attributes this to a 'fibrositis' or inflammation of the connective-tissue elements of the muscles, the coverings of tendons and nerves, whereby we get lumbago, wry-neck, stiff-neck, cramp in the muscles, sciatica, and neuralgia of various parts. Stockman[28] says there is a congestion of the muscles and fibrous coverings, and an increase in the fibrous elements of the affected muscles, nerves, joints, and bones. The increase of fibrous elements gives rise to swellings of a size varying from a pea to a walnut, which can be distinctly felt in the coverings of muscles and joints. These swellings cause constant aching and muscular fatigue; sudden movements increase the aching and cause excruciating pains. When sensory nerves are affected, the pain radiates over a wide area, and may be accompanied by change of sensation, as pricking, tingling, numbness.

It is possible that the cause may be an irritation by microbes or their toxins. In acute rheumatism various micrococci produce formic and acetic acid by the decomposition of sarcolactic acid, which is one of the ordinary products of muscular activity. An albumose is also obtainable from the *Micrococcus rheumaticus* which is capable of sending the temperature up 3° or 4° F. and causing acute inflammation of joints. In chronic rheumatism there is a similar formation of toxic material: its nature, however, is not clearly understood: but whether it be uric acid, lactic, formic, or other organic acid, it arises from defective metabolism,[29] which process is disturbed in some way by a combination of cold and damp, and causes the production of the *materies morbi.*

Treatment.—When there is a distinct personal or family history of gout, the treatment must be that which is detailed in the section dealing with it. In all other cases the *diet* may be a moderate mixed diet, consisting of ordinary plain food in sufficient quantity to meet the requirements of the body. It should be light, nutritious, and easily digestible: meat, fish, oysters, poultry, and game may be taken in moderation; milk

puddings of all kinds, milk, cheese, and eggs; potatoes, most kinds of green vegetables, salads, and fruit, are valuable for their salines. A vegetarian diet suits some people the best. Carbohydrates, such as bread, pastry, and sugar, should not be eaten in excess, and all kinds of indigestible food should be avoided. Butter, cream, and fat meat may be eaten abundantly, especially when the nerves are affected. Tea and coffee may be allowed to the extent of one cupful at a meal. No alcohol should be taken if the individual temperament will bear total abstinence; if not, we may allow a little dry cider, light wine, as Hock or Moselle, or diluted spirits, in preference to malt liquors. The best beverages are lemonade and pure water.

Residence in a warm dry climate, free from frequent changes of temperature and fogs, is important. Living on a clay soil or in a damp region which is much affected by fogs should be avoided. Change of air to a high and dry bracing climate like that of Buxton or Clifton is very good; also to Bournemouth or other warm seaside place which is not too humid; but the seaside is unsuitable for some persons, especially those places which are exposed to north or east winds. Catching cold must be avoided; sea and river bathing are forbidden; the patient should wear flannel underclothing, woollen stockings, and stout boots with an inner lining or cork sock.

If a person have an acute attack of lumbago, stiff-neck, or sciatica, he should rest absolutely. Hot fomentations are very good for some cases; the application of dry and radiant heat by means of a hot flat-iron applied over flannel, or similar means, for others. Free perspiration, best obtained by Russian or Turkish baths, gives great relief. Lumbago is sometimes relieved by the free perspiration induced by wearing an overcoat during a long walk. The pain is usually increased by exercise and movements generally, but is relieved by gentle massage—*e.g.*, stroking or light friction with an embrocation or the dry hand, followed by passive movements.

When the trouble has lasted a long time, ultimate benefit may be derived from exercises calculated to stretch fibrous tissues or break down adhesions, by gymnastic movements with a stick, clubs, dumb-bells, etc. Passive movements come under the head of massage. Electricity is also useful in this stage, especially a

rapidly interrupted faradic current, so weak as to cause only a sense of vibration, not of pain or pricking, for ten or fifteen minutes at a time; it assists in causing a shrinkage of swollen fibrous tissues. The induced current applied by an electric brush is also good. Strong currents increase the pain. In sciatica, galvanism should be begun in the second week, one pole being applied over the sacrum and the other over the most tender spot.

Counter-irritation by means of flying blisters, iodine paint, oil of mustard, horse-radish, or capsicum, is also very good.

Treatment by hot air or radiant heat is valuable; it is applied by the apparatus of Tallerman, Dowsing, Biers, or Schrieber; the last is said to be the best. The apparatus should have at least two openings in it for ventilation, otherwise there will be very little diffusion of the hot air, which consequently becomes damp from the perspiration and irritating to the affected part. The object of this treatment is to produce an active congestion of the part, which results in a reduction of the swelling, clears away deposits of toxic materials, and improves general tone. The same effects are claimed for another method of treatment by Biers, which is as follows: The circulation of the affected joint or limb is almost completely arrested by an elastic bandage over a layer of cotton-wool; it is applied daily to the joint and a little above and below it for five to twenty minutes, the time being gradually increased. On alternate days, and sometimes every day, after the former application the joint or limb is bathed with hot water at 120° to 130° F. In the intervals the joint is kept in a splint well padded with cotton-wool.

Massage may be applied with advantage to painful muscles or joints, especially in chronic rheumatism. When nodules or swellings can be felt in the muscles or fibrous tissues of the back, loins, thighs, or joints, this treatment should be begun by gentle effleurage, which will be soothing and comforting. Indurated nodes are too tender to bear more than that at first; by-and-by they become less painful and will bear firm rubbing or kneading with the fingers or knuckles for ten or fifteen minutes at a time.

In recent rheumatism two or three weeks of massage is enough; but old rheumatism with indurated swellings may require six or twelve months' treatment.

A few words upon massage may be useful. *The movements* of

the masseur are as follows : **Friction**, or rubbing the surface of the limb with the fingers. **Effleurage**, or stroking the part with the palm of the hand, one or both hands being used in a regular manner and with more or less rapidity. The movements are towards the heart, and are usually done with the dry hand, but oil, vaseline, or embrocation, may be used at discretion. **Petrissage** consists in picking up a piece of muscle or flesh with the thumb and fingers, and rolling it backwards and forwards; or the muscle is subjected to firm pressure by rolling it between the fingers and subjacent tissues. **Tapotement** consists of percussion of the part with the finger-tips, fingers, palms of the hands, or the edge of the half-closed hand. **Kneading** is a more energetic form of the latter, and is applicable to the abdomen, back, or limbs, the knuckles of the hands being used.

The effects of massage are chiefly upon the circulation and metabolism. **Local massage** stimulates the cellular nutrition and metabolism, and improves the lymphatic and blood circulation. It materially assists in removing deposits, indurations, toxic materials, and the products of defective metabolism from the part to which it is applied. **General massage** stimulates the whole vital functions, improves the circulation through the skin and muscles, stimulates organic changes, and improves the functions of the nerves. The result of experiments on massage by Lauder Brunton and others show (1) that the flow of blood through the muscles is increased during the massage; (2) that there is an accumulation of blood in the muscles immediately after massage, followed by an increased flow through them; (3) that peripheral resistance to the circulation is reduced and arterial tension falls; (4) that gentle massage causes a larger drop in the blood-pressure than alternate compression and relaxation of large bloodvessels or muscles.[30] Mitchell has likewise shown that there is an increase in the proportion of the red blood corpuscles after general massage,[31] which is beneficial to the patients.

Mechanical vibrations and electrical vibrations are sometimes used as a substitute, and are of value in many cases where local massage is indicated. Bechterew made observations upon a number of healthy persons with vibrations ranging from 128 to 286 per second. These caused a diminution of heat-loss from

the skin, the external temperature being lowered, while that in the rectum was increased; the pulse was first slowed and then quickened, the respirations prolonged, and most persons were sleepy at the end of the sitting.[32]

Local massage is suitable for most people. General massage is said to be quite unsuitable for persons of a nervous or sanguine temperament, because they do not need stimulation of any kind; it exhausts them and intensifies their nervous condition; it is good for persons of the bilious, phlegmatic, or lymphatic temperament, and for hysterical persons with defects of the nerves of the skin or sluggish reflexes. People with most kinds of chronic ailments may be massaged, and the comfort and peace which follows it is usually beneficial; the feeling of well-being and the refreshing sleep which it often induces has a decidedly favourable effect upon their system.

Baths.—Spa treatment consists of (*a*) hydrotherapy, (*b*) drinking the waters.

Hydrotherapy may cure recent rheumatism, but old-standing cases usually only get temporary relief. When combined with massage it promotes the absorption of indurations. This method of treatment depends for its results upon (1) the temperature of the water, (2) the volume or quantity and extent of its application, (3) the force of its impact. Its successful application also depends upon a proper reaction without undue stimulation following its use. It does not interfere with the action of drugs, and is usually combined with regulation of the diet, rest or exercise, change of air and water, massage, and electricity. Winternitz says* 'that water of the temperature of 90° F. is neutral to the human body; that to produce a remedial effect it must be used above or below that degree.' *Warm baths* applied to the whole surface of the body are soothing; they cause a dilatation of the superficial bloodvessels, a feeling of turgesence and warmth, with increase of perspiration and respiration. The physiological result is an increase in the radiation of heat from the body, and of the amount of water excreted from the skin and lungs, with a corresponding increase in the excretion of carbonic acid and other waste materials. The intestinal movements or secretion may be lessened and constipation induced. The general

* *Advanced Therapeutics,* 1902, xi., 752.

effect is a tendency to drowsiness, temporary languor, and mental inactivity, which, however, is soon followed by a corresponding reaction. General *hot baths* produce these effects in an increased degree. A local hot bath raises the temperature of the part, stimulates the local circulation, attracts blood from distant parts, increases the radiation of heat and evaporation of moisture, soothes the nerves, and is thereby anodyne. A hot fomentation or poultice is practically a local hot bath; the general result of such an application is a freer circulation of blood through the part, increased metabolism, reduction of swellings or indurations, and relief of pain. Baths of 95° to 100° F. are preferable to those of higher temperature. A full bath of 105° to 110° F. is sometimes used, but care should be taken that the heart is sound, as syncope may be induced by it. Local hot baths or fomentations at a temperature of 120° to 130° F. are used with benefit.

A *hot douche* is applied to affected joints, muscles, and over various organs at a similar temperature in a single or divided stream to the most tender spot—*e.g.*, in sciatica along the buttocks, hips, and down the back of the thigh. The size, height, and direction, as well as the temperature of the stream, have an influence upon the effect of the douche. A *cold douche* is sometimes applied to affected parts; it cools the part to which it is applied by causing a contraction of the bloodvessels, but it is speedily followed by a reaction or glow of warmth and increase of the circulation due to a secondary dilatation of the same vessels. The 'knee-douche' consists of a stream of cold water from a hose-pipe or watering-can applied to the lower extremity. The stream is applied first to the heel, then up the calf of the leg, round to the front of the knee and downwards. It is very unpleasant at first, and may cause a rush of blood to the head, but it is said to stimulate the whole nervous system. It is applied for thirty to ninety seconds, and only repeated occasionally. The application is always stopped when the skin becomes red; it is said to be of most value in cases of gout and chronic rheumatism. Russian or vapour baths and Turkish or hot-air baths do less good in chronic rheumatism than ordinary warm-water baths, or such water to which an alkali has been added. Bathing at the Spas of Buxton, Bath, Harrogate, Droitwich, Woodhall, and Strathpeffer in Britain; of Aix-les-Bains, Aix-la-Chapelle, Baden-

Baden, Contrexéville, and Wiesbaden in Europe; and of Hot Springs, Arkansas, in the United States, is very suitable. *Mud-baths* at Salsamaggiore and other places are frequently beneficial.

Drinking the Waters.—The waters which contain much lime in a natural solution are much extolled for rheumatism—those of Buxton, Bath, Contrexéville, St. Galmier, Tarasp, Pougues; and the Bonifacius, Saratoga-Vichy, and the Seltzer waters at Mendocius in America, are good. Next in importance are the brine waters of Droitwich in England; the Homburg-Elizabeth, Kissingen, Aix-la-Chapelle, Johannisbrunnen, Taunus, and the Roman Spa in Europe; the Albany Artesian, the Lansing, and the Hat-horn Springs in America; and the bromo-iodine waters of Woodhall Spa, England, and Salsamaggiore, Italy. All alkaline waters, which by their regular consumption dilute the liquids of the tissues, wash out waste materials, and prevent the deposits which give rise to gouty or rheumatic symptoms, are useful for home consumption.

Climate for winter resorts: Italy, *Genoa*, the Riviera, *Mentone*, *San Remo*, Madeira, Canaries, Bermuda, Algeria, Egypt, Morocco; in America, Long Island, parts of Colorado, Texas, California, and South Carolina; in Britain, the Isle of Wight, the Scilly Isles, Cornwall, South Devon, Hastings, Tenby, Aberystwyth, Clifton, Bournemouth, South-West Ireland, provide a suitable residence for this class of people.

CHRONIC RHEUMATIC GOUT (ARTHRITIS DEFORMANS).

This is probably a mixture of gout and rheumatism; it is more common in women than men, and in poor people rather than the rich. If it is of gouty origin, there will be a history of ordinary attacks of gout in earlier years; possibly chalk stones are to be felt in the ears and affected joints, or there has been uric acid gravel in the urine. If of rheumatic origin, there would probably be a history of rheumatic fever, of having lived a long time on a clay soil, or been much exposed to wet and damp.

The treatment must be a modification of that for chronic rheumatism. A **generous diet** should be given, including fish, poultry, meat, eggs, milk, cream, butter, plenty of fresh

vegetables, with nourishing wine or spirits. Most kinds of food are permissible, provided they do not cause indigestion; cod-liver-oil and other fats are serviceable. Warm flannel clothing, residence in a warm dry climate, massage, counter-irritation to the joints, and galvanism are very useful. The consumption of food containing sulphur, as onions, mustard, or horse-radish, and the internal administration of sulphur or its application to the joints on flannel is good. Treatment at the Spas by sulphuretted or ferruginous waters, at Harrogate, Leamington, Teplitz, Eger, Kissingen, or Homburg, may give relief.

GRAVEL, OXALURIA, LITHÆMIA.

Defective metabolism, deficient oxidation, diseases of the liver, and other conditions, lead to the formation of an excessive amount of uric acid, or its insufficient elimination. The conditions which produce lithæmia, uric-acidæmia, and gravel, are practically the same as lead to gout, and require similar treatment.

The effect of **lithæmia** is to produce weariness, languor, depression of spirits, melancholy, unrefreshing sleep, dyspeptic symptoms, flatulence after eating, sluggish bowels, and intermittent pulse. It is very common among professional men who have great mental work to do, men of literary habits, those who have a sedentary occupation and get little fresh air or exercise out of doors. Excess of uric acid in the blood is a frequent cause of *migraine* or sick headache, and of neuralgia, sciatica, and various gouty or rheumatic affections, which render the person unable to perform with pleasure the duties of life.

Gravel is one of the troubles arising from undue accumulation of uric acid in the blood and tissues. The crystals of uric acid are deposited in the urinary passages and voided in the urine, when that liquid is too acid, too concentrated, or otherwise unsuited for its solution. The little particles form a sandy or brick-dust sediment of lithates, or look like cayenne pepper in the utensil, or form larger masses of gravel varying from a pin's head to a pea in size. This trouble is common in the gouty, when aided by high living and a sedentary occupation. It is a frequent cause of backache, of heat or scalding in the urethra,

frequent micturition, strong acid urine, and occasionally blood in the urine. Oxalic acid gravel or **oxaluria** is a deposit from the urine of crystals of oxalate of lime in a pale, gray, mucus-like sediment. Oxalic acid is a congener of uric acid; its production is due to a disturbance of metabolism, and increased by an excessive consumption of vegetables which contain it. It is usually preceded and attended by indigestion, languor, mental depression, hypochondria, or other nervous symptoms.

But over and above the deposits found in the urine are the stones or **calculi** formed in the pelvis of the kidney or bladder, which may consist of pure uric acid, urate of sodium, xanthin, oxalate of lime, triple phosphate, and phosphate or carbonate of lime. The nucleus of each calculus is usually uric acid or sodium biurate, but the starting-point may be urinary casts or a small blood-clot. Their formation is frequently begun in the kidneys. According to Rolfe, the kidneys fail to excrete uric acid or oxalate of lime brought to them by the blood, and these substances become fixed in the cells and bound together by a matrix of colloid material; once started they grow by accretion. Roberts showed that their formation is favoured by great acidity of the urine or a decrease in the salts of the blood. Normal urine will deposit uric acid if it is allowed to stand three or four hours, which is physiological; but if the uric acid is deposited in the urinary organs, or in the utensil soon after the urine is passed, it is pathological. The reason why we do not normally pass uric acid in our urine is because the salts of the urine prevent its deposit. Alkalinity of the urine always postpones, and acidity hastens, the breaking up of urates in the body and precipitation of uric acid gravel. Therefore salts of soda, potash, lithia or lime, by rendering the urine alkaline, will prevent or cure gravel. Potash is the best. When uric acid is in excess in the blood, sodium carbonate will form sodium biurate; this is less soluble than sodium quadurate, the normal form in which it exists in the blood. Lithia dissolved in the stomach is readily taken up by the blood and forms with uric acid a soluble salt which is readily washed out.

The Diet. Briefly, give an abundance of pure water, or water which contains an alkali, alkaline carbonates, or chlorides. Reduce the consumption of animal food to the minimum which

will supply the nitrogen required for daily consumption ; better still, replace all animal food by a **purin-free diet**, consisting of milk, eggs, cream, butter, cream cheese, new-milk cheese, or cheese, with rice pudding or farinaceous foods (of which oatmeal is highly recommended), fruit, cooked vegetables, salads, and white bread ; plenty of salt should be eaten with everything. Very little tea, coffee, cocoa, or alcohol ought to be consumed. Coffee and beer are positively injurious, by preventing the excretion of waste products ; experiments show that both these substances decrease the output of urea, and that the excretion of urea is the greatest when they are withheld. All purin-bearing substances must be reduced in amount ; it should therefore not be forgotten that peas, beans, lentils, onions, asparagus, and other vegetables contain purin, and also nuclein which is decomposed in the body into purin bases.

The diet should therefore be that which has already been detailed for gout. There are, however, differences of opinion on the matter : some authorities say avoid fat meat, sugar, and fruit, and live chiefly upon milk and carbohydrates ; others say eat meat and reduce carbohydrate and fat, as in the Salisbury treatment. But it is quite certain that *excessive* consumption of any kind of food may lead to the formation of gravel or stone ; it is therefore wise to allow only a moderate amount of diet on the normal lines, checking all excesses, and especially avoiding the substances which are known to increase or favour the formation of uric acid. Alcohol in any form increases uric acid formation, and its consumption must be checked.

The salines of the blood and urine are deficient in all cases of gravel, which is one cause of its production ; therefore foods which are known to be specially rich in them ought to be consumed freely. Roberts gives the following table showing the percentage of salines in flour to be 0·51, rice 0·39, milk 5·6, meat 5·2, fish 7·0, oysters 23·0, vegetables 11·0, and salads 12·0. Stone rarely affects the children of well-to-do people, and the fact that the poor are so often troubled by it is because they live more upon the cereals, which are poor in salines.

The value of common salt as a prevention and cure of gravel and stone is evidenced by the fact that sailors and other men who live largely upon salted meat are rarely troubled by these

affections; and the same remark applies to people who constantly drink brackish waters. Another explanation of the fact that salted or dried meat does not cause gravel or stone is that in curing it some of the meat-juice containing purins is lost, in consequence of which such meat contains less extractives or purin-bodies than fresh meat; it is indeed true that some of the muscle-serum containing albumin and salts is lost by 'salting' the meat, but that can hardly reduce it to a purin-free material, so that the effect is probably very largely due to the added salt.

People who are subject to the **oxalic acid gravel** must avoid all kinds of food which contain oxalates—*e.g.*, spinach, sorrel, rhubarb, tomatoes, beet, celery, haricot beans, grapes, plums, gooseberries, currants, strawberries, raspberries, pepper, black tea, cocoa. Oxalic acid is a congener of uric acid, and its formation in the body is due to defective metabolism; wherefore a purin-free diet is the best, although animal food of a digestible quality is admissible. Toepfér* does not think oxaluria is increased by vegetables which contain oxalic acid; but that an excess of lime in their food leads to it—*i.e.*, oxaluria patients either take too much lime in their food, or their metabolism in respect to it is defective. He suggests a different diet according to the type of patient who has the trouble, a meat diet doing good in diabetic patients, but should be withheld from uratic ones; that an abnormal digestion of carbohydrate or proteid material requires a re-adjustment of the food; but the only cases in which he withholds foods known to contain oxalic acid are those in which there is a marked tendency to the formation of calcium oxalate stones.

In all cases the digestion must be aided by fresh air and exercise, or by medicine when necessary. Massage will assist in improving the metabolism and general tone of the system. An abundance of fluid should be drunk to dilute the blood, wash out the cellular tissues, and increase the action of the kidneys, for which purpose free potations of pure or distilled water answer very well. But inasmuch as the salines of the blood and urine are below the normal, and such deficiency induces a deposition of uric acid, we must increase those salts as well as we can by giving them in water. For this purpose the carbonate or citrate

* *Wien. Klin. Vorträge*; *Brit. Med. Jour.*, 1904, i., Epitome, 353.

of the alkalies is proper; equivalent doses are lithia 5 grains, soda 12 grains, potash 14 grains, potash being the best. They may be formed into an aerated water, each siphon of which may be arranged to contain a daily dose; or they may be taken in plain water. A large dose of such a salt should always be taken at bedtime to keep the urine alkaline during the hours of sleep, for the precipitation of uric acid and formation of gravel is most favoured by long abstinence from food or long retention of the urine in the bladder. The mineral waters most suitable for this purpose may be classified thus:

The alkaline waters of Apollinaris, Vichy, Ems, Vals, Carlsbad, and Wildbad in Europe; Hot Springs, Virginia; Bethesda, Wisconsin; Congress Spring, California; and the Oja Caliente in New Mexico, U.S.A.

The lithia waters of Bonifacius in Germany, the Buffalo Lithia, Harris Lithia, and Geneva Red Cross waters of the United States.

Waters containing a natural solution of **salts of lime** with carbonate of soda, as those of Bath, Buxton, Tarasp, Contrexéville, St. Galmier, Wildungen, and Pougues in Europe; and the Saratoga-Vichy or Seltzer Spring at Mendocius in U.S.A.

The saline waters rich in chlorides of Woodhall Spa, Aix-la-Chapelle, Kissingen, Roman Spa, Salsamaggiore, Johannisbrunnen, and Taunus in Europe; the Albany Artesian, the Lansing, and the Hat-horn Springs in America.

Baths of the same waters may be used, whereby the general metabolism is promoted.

The waters which are aerated or contain much carbonic acid gas are the pleasantest to drink, and are usually drunk cold or nearly so; those which are not well aerated are better drunk warm. It is not necessary to be always drinking these waters. The formation of uric acid should be looked upon as a bad habit, and the sign of an attack of gravel coming on is a pain in the back or a deposit in the urine in the morning. The kidneys and tissues of the body should then be flushed with water to remove such material; but when the symptoms are abated the patient should be treated chiefly through the food. When, however, a stone exists in the kidney or bladder, or deposits form about the joints, a much longer course of waters is necessary.

ANÆMIA AND CHLOROSIS.

Anæmia occurs in very many diseases as a secondary effect from constant discharges, frequent loss of blood, and hæmorrhages of every kind and degree. It is, however, frequently a primary disease resulting from deficient digestion or assimilation of food, from working in hot and ill-ventilated rooms, and long residence in a tropical climate. Defective metabolism induces such a condition that the formation of red blood corpuscles and hæmoglobin is deficient, or their destruction is excessive. Hypochlorhydria and atony of the stomach are frequently associated with it. Anæmia occurs as the result of many diseases, but special groups are made of disease of the spleen, lymphatic glands and bones, and other diseases in which the white blood-cells are produced in abnormal quantity; of blood poisons, such as syphilis and malaria; of cases arising from hæmoglobinuria and the malarial parasite; of the worm (*Bothriocephalus anæmiæ*) and ankylostomiasis. Pernicious anæmia is due to obscure causes, but is often very progressive and fatal.

In the treatment it is of the first importance that the organs of digestion and assimilation be put into working order, that they be constantly watched so that nutrition may be promoted. Oxygen is very important; it is life-giving and strengthening, the vital force of the blood; but carbonic acid gas, carbon monoxide, and the gases which pollute the air from the combustion of coal-gas, by leakage from drains or sewers, and in overcrowded rooms, are poisonous and very destructive to the blood. Brown-Seguard[33] found in the air expired by human beings and animals a poisonous volatile principle far more dangerous than carbonic acid; it diminishes the power of respiration, produces debility, induces a sort of paralysis of the extremities, and is fatal to animals. To obtain abundance of fresh air and avoid the respiration of deleterious gases is therefore equally important. Such patients must avoid the use of tight corsets or waist-bands, which, by constriction, interfere with respiration and, consequently, the oxygenation of the blood. They must avoid overheated and badly ventilated apartments, and take regular exercise in the open air. In bad cases entire rest of the body may be necessary until some im-

provement is made; at any rate, they should get up late and go to bed early, and should have the windows of their apartments open day and night, and during fine warm weather they may lie in a hammock out-of-doors. In all ordinary cases exercise, short of fatigue, should be taken every day. Deep-breathing, dumb-bell, and other gymnastic exercises not only exercise and strengthen the muscles, but they expand the lungs, stimulate the circulation through them, and expose a larger amount of blood to the air, whereby oxygenation is improved. Walking, running, jumping, skipping, tennis, badminton, golf, riding horse-back, all increase the depth of breathing and, consequently, the oxygenation of the blood. Girls, as a rule, leave off their hoop, skipping-rope, and other outdoor games too early in life, which is one of the reasons they so readily become anæmic. Rest in bed is necessary in severe cases; it benefits the neurasthenia, reduces the destruction of blood-cells, and regulates gastric functions.[34]

The food should contain plenty of meat and all kinds of animal food: scraped meat, raw meat (which is digested more easily than cooked meat), underdone meat, bone-marrow, eggs, milk, cream, fat of ham or bacon, and any other kind of fat; also oat-meal porridge, maize-meal mush, or polenta. Salads and all other digestible green vegetables are valuable; the latter must be taken as consommé or purée if otherwise indigestible. Plenty of salt should be eaten with all food, and, if it seems desirable, the digestion may be aided by the use of pepsin or other artificial digestant. Milk and gruel may also be peptonized before being taken. A little porter, stout, port, burgundy, or Australian wine may be allowed; they encourage nutrition and stimulate appetite. A few things should be avoided—*e.g.*, clear soup or broth, hashed meat, and salted or dried meat, which has already lost some of its nutriment and is not so easily digested; also vinegar, pickles, lime-juice, lemons, and all foods which cause indigestion (*q.v.*). Vinegar is capable of causing a high degree of emaciation, lessens the alkalinity of the blood and the number of corpuscles (Bauer).

The meals should be frequent: a cupful of hot milk ought to be taken on waking in the morning; *breakfast* should consist of porridge followed by an egg, fish, fat smoked bacon, or fresh meat, with bread-and-butter; *lunch* in the middle of the morning, consisting of a raw egg and milk, raw-beef tea, a little scraped meat in port

wine, and a biscuit or two; *dinner* at midday ought to consist of thickened soup, underdone meat, game, poultry, vegetables, potato, fruit, or milk pudding; *tea*, consisting of bread-and-butter with honey, jam, or marmalade; *supper* should be more or less like dinner, and *must* contain either meat, fish, or porridge.

Two things are necessary for the formation of good blood: iron and certain salts. The percentage of iron in wheat = 0·26, oatmeal 0·67, maize 1·23, barley 0·97, rice 1·23, rye 2·54, potato 1·18, from which is seen that these are important articles of food. Milk, which is so valuable in other respects, is deficient in iron; but this element is abundant in meat, especially liver and spleen, and raw meat is one of the best means of getting it. The salts of iron have long been used in the treatment of anæmia and other diseases dependent upon an altered state of the blood, and much benefit is derived from their general tonic influence. But there is an absence of direct evidence to show that inorganic preparations of iron are really capable of entering into the composition of blood-cells; indeed, the available evidence is rather against it. Organic forms of iron, on the other hand, such as exist in meat, especially in liver, spleen, and other animal and vegetable albuminous substances which compose our food, are readily assimilated, and pass into tissue and blood formations. All organic forms of iron are therefore good in anæmia and chlorosis, and of especial value to the dwellers of towns and those who live and work in close, ill-ventilated rooms or warehouses. The normal supply of iron to the body is hæmatogen, an iron-containing compound of the nature of nucleo-albumin in animal and vegetable cells. If growing animals are deprived of this they waste, in spite of the administration of inorganic iron salts.[35] Experiments show that animals who are fed on food which does not contain iron lose 40 per cent. of the total iron in their body in three weeks; but when they are fed on food containing organized iron, that substance is absorbed from the duodenum and jejunum, the iron is stored in the liver and spleen, the red blood cells increase in number, and iron is excreted by the liver, kidneys, and large intestines.[36] Stockmann[37] states that the ordinary daily diet contains 9 or 10 milligrammes of iron, but that of chlorotic people who take but little food only about 3 milligrammes. He further states that:

1 litre* of milk contains 2 to 4·3 milligrammes of iron.				
100 grammes of dried bread contain 0·85 to 1 milligramme of iron.				
,,	,,	dried oatmeal contain 3·5	,,	,,
,,	,,	yellow ox-marrow contain 2·5 to 4·0	,,	,,
,,	,,	red calf-marrow contain 7·6 to 8·7	,,	,,
,,	,,	dried beef-steak contain 3·9	,,	,,

* About 900 grammes.

The importance of the salines for the composition of the blood is well known, and foods which contain them are essential in anæmia and chlorosis—*e.g.*, milk, meat, fish, oysters, and particularly green vegetables and salads. Potassium salts are abundant in all green plants in the form of tartrates, citrates, malates, and oxalates, likewise in potatoes and cereals; phosphorus, mainly as phosphate of potassium, in the cereals. Iron plays an important part in the formation of chlorophyl in plants, and its presence in green vegetables of all kinds is a point worthy of observation in the treatment of anæmia.

In the treatment of some cases of anæmia and chlorosis change of air and mental rest in a high and dry region is essential, especially when overwork, overstudy, or mental distress has been a factor in its causation. Buxton, Matlock, Malvern, and Clifton are suitable places. Margate and Brighton are serviceable in some cases, and so are numerous foreign health resorts.

Drinking the sulphurous or ferruginous waters is highly recommended at Harrogate, Leamington, Pitkeathly, or that of Flitwick in Britain; at Pyrmont, Spa, Homburg, Birmensdorf, Orezza, St. Moritz, Aix-la-Chapelle, Barèges, Bagnères, and Enghein; also the arsenical waters of La Bourboule, Levico in the Tyrol, and Roncegno in Italy; or the various sulphate of iron waters in the United States. Opinions differ as to the value of inorganic iron even in water. Bunge, Mörner, and others assert that it is not absorbed, and is only beneficial by removing sulphuretted hydrogen from the bowels, and checking putrefactive processes which destroy hæmatogen in the intestine. Other observers, including Noorden[38] and Stockmann,[39] assert that inorganic iron is absorbed, and is very efficient in the treatment of anæmia and chlorosis, thereby bearing out the experience of centuries in the use of ferruginous waters.

SKIN DISEASES.

Many diseases of the skin are associated with a disturbance of the metabolic functions of the body, whereby an irritation is caused, and various forms of inflammation of the integument produced in persons predisposed to them. Thus eczema often occurs in the gouty. It occurs in ruddy and robust persons as well as the ill-nourished, and we can often find errors in the diet which have contributed to its causation. Boils are indirectly due to the diet or faulty metabolism; acne is often the result of injudicious feeding, and acne rosacea is a frequent result of intemperance. Urticaria or nettle-rash is a frequent result of unsuitable food; lichen, especially the form known as 'prickly heat,' is induced in some people by indiscretion in diet combined with a hot climate. No special article of diet can be impugned as a cause of psoriasis, but alcohol aggravates it. Too limited an amount of liquids to enable the kidneys to perform the function of eliminating waste products promotes the gouty tendency which underlies some forms of eczema. The persistent omission of fresh green vegetables, salads, and ripe fruit from the dietary leads to a weakening and loosening of the tissues, with alteration of the blood or bloodvessels, and a condition of the integument which in its highest development is scurvy.[40] The excessive consumption of sugar and all things containing it is said to be a cause of eczema, and the cessation of its use facilitates the cure,[41] and all skin diseases are aggravated by unsuitable food.

In acute affections of the skin, as acute eczema, urticaria, erythema, purpura, erysipelas, scarlatina, measles, roseola, chicken-pox, small-pox, the diet must be similar to that required in all other forms of acute illness. When it is attended by feverishness it must consist of milk, sometimes diluted with an alkaline water, milk puddings, custard, junket, jelly, isinglass and milk, eggs, and farinaceous foods. If the temperature is normal we may add to the list veal or chicken broth, light fish—*e.g.*, sole, plaice, whiting, or turbot—a little chicken, pheasant, or rabbit, then boiled mutton, plenty of good bread-and-butter, and milk-puddings. Perhaps a little light wine may be useful for adults and a few drops of brandy for children. In **urticaria** the treatment is best begun by giving an emetic and purgative to

remove the offending material which has caused it; and saline purgatives are useful in most acute affections of the skin.

All chronic skin diseases should be treated according to the cause. The diet must be that suitable to any disease which complicates it. When, however, there are no special indications, we must give due attention to the stomach and eliminating organs, and all foods calculated to upset the stomach and liver must be avoided (see 'Indigestion'). In many chronic affections of the skin the disease is of an exhausting character. It is not unusual to hear those afflicted say that they cannot perform their duties with the zeal and energy of former days. In very many cases there is a decided condition of subnutrition or malassimilation, and in others the food is not sufficiently nutritious for them. The absence of suitable food and the non-observance of proper meal-times aggravates many skin diseases. Sometimes these people work too hard and exhaust themselves, or they worry and allow themselves to become anxious about their affairs, whereby the condition of exhaustion is increased or readily induced. Many patients, because they are too exhausted to eat or from want of appetite, go without food in the middle of the day; or they have tea and bread-and-butter, perhaps with a sausage or bloater or some other insufficient source of proteid as a 'relish.' These methods are very far from assisting to cure skin diseases, and they must be improved. There must be proper meals and intervals of rest, and an attempt should be made to remove friction, worry, anxiety, and all causes of nervous and physical exhaustion.

In a very large majority of chronic cases—*e.g.*, eczema, psoriasis, acne, urticaria, lupus, lichen, and scrofuloderma—the food may consist of the ordinary and customary articles derived from the animal and vegetable kingdoms—that is to say, *a mixed diet*—care always being taken to avoid all things which will cause indigestion and liver complaint (*q.v.*). The patient must *avoid* salted and dried meat or fish, pork, veal, shellfish, pickles, spices, dressed dishes, hashed meat, soup containing coarse vegetables, oatmeal, new bread, bran bread, and sometimes potatoes, *strong* tea and coffee, wine and malt liquors. Salted meat is not suitable, because some of the nutritive substances as well as extractives have been drawn from it by the salt, and the fibres hardened

and saturated by salt and saltpetre, which are mischievous. Meat preserved with sugar is not so bad. Sugar withdraws less of the juice of meat than salt; it does not alter the taste, but forms a solid crust around the meat, which may be washed off before cooking.[42] Sugar and cheese are objected to by some authorities. Milton[43] sees no reason why they should not both be taken in moderation; but Macdonald[44] asserts that the excessive use of sugar in any form is a predisposing cause of eczema, and cessation of its use facilitates its cure. Potatoes are objected to by others; but surely they only object to an excess of carbohydrate, for potatoes are an excellent antiscorbutic and a valuable addition to the dietary in most skin diseases, because of the salines contained in them. An absence of fresh vegetables from the food is evidenced in many persons by scurvy, spongy gums, indented tongue, foul breath, tendency to bleeding, coarseness of the skin, and muddy complexion. Green vegetables, salads, and most kinds of fruit, are valuable in skin affections. Tea and coffee are the best stimulants, but must not be taken to excess. Lemonade made with fresh lemons, and lemon juice diluted with an aerated water or an alkaline water or with cold tea, is a suitable drink, especially in the weeping stage of eczema.

Monotony of food causes skin diseases in some persons, wherefore they are common in boarding-schools and other institutions where a regular round of diet is observed. Variation of the diet is absolutely necessary, for monotony even of the best kinds leads to satiety, loathing of food, and malnutrition. The better the feeding, so long as the material is digestible, the healthier the skin should be. But extremes are mischievous; high-feeding and overfeeding are as bad as starvation. Too much animal food is injurious, for eczema is often seen in large eaters of meat.

Many temperate persons and total abstainers are afflicted with skin diseases; but we usually find that an excess of alcohol is a cause, or a very common means of aggravating them. Beer and malt liquors are very injurious. Sweet wines—*e.g.*, Madeira, Marsala, sherry, port, and sweet champagne—are equally deleterious. When a little stimulant is necessary it should consist of claret, Burgundy, *real* Tarragona, a glass of *old* port, a little Hock, Chablis, Sauterne, Saumur, or dry champagne.

Children with eczema, impetigo, ecthyma, and similar affections,

should have plenty of good bread-and-butter, milk, milk puddings, farinaceous foods, broth, light fish, eggs, chicken, rabbit, a little fresh meat, with potato and vegetables. Too much animal food is injurious to them, especially *lean* meat. Chicken, rabbit, and fish are less stimulating than meat, though there is practically no difference in the amount of extractives yielded by either of them. Uncooked milk is said to be prejudicial to children with skin diseases, and condensed milk is certainly not a correct food for them. Shellfish, the coarser kinds of vegetables and fruit, and sweetmeats, must not be permitted.

In chronic **urticaria** and **psoriasis** the food should be similar to that detailed above. Fat ham, fat bacon, or a little fresh meat, may be eaten for breakfast, after which time the less butcher's meat the better. The midday meal may consist of clear soup of mutton, veal, or chicken, thickened with vermicelli or macaroni; chicken, pheasant, rabbit, and nearly every kind of fresh fish, may be allowed (but heating sauces must be avoided), and eggs in every form; potatoes, yams, peas, beans, lentils, haricot beans; milk puddings. In **lichen** the food must be light and unstimulating, all heavy materials being avoided, as well as ale, stout, and everything liable to cause indigestion. **Lupus** also requires an essentially light diet, but it must be nutritious and sufficient to supply the needs of the economy. Oysters and poultry are good, but highly stimulating food, including heating wines, is injurious.

Boils and carbuncles necessitate a thoroughly nourishing food, and a liberal supply of good port wine is beneficial for the latter. In **acne** the diet should be the same as for eczema; but only a small amount of meat should be taken, especially at the midday meal, and only potato as a vegetable.[45] Tea, especially China tea, is good for these cases, but all kinds of indigestible food, heating sauces, and stimulants must be avoided. **Acne rosacea** is frequently due to debility. In men the most common cause is intemperance, by which metabolism is disturbed and the health deteriorated. In women the most common cause is a disturbance of the menstrual functions, whereby debility is induced. The diet may be that for chronic eczema. All kinds of stimulant are not equally bad for this complaint. Beer is less deleterious than wine or spirits, and some wines are less so than others. A light

Rhenish or Austrian wine, being poor in alcohol, is not so likely to cause or increase it as the fiery and spirituous wines of Hungary and Spain. A moderate amount of light red wine is beneficial to most women, when accompanied by a generous diet; but wherever alcoholic excess is suspected to cause or aggravate the disease it must be given up entirely.

Besides attending to the diet, we must look after all other matters which have an influence upon the skin. In particular we must give due attention to the functions of the digestive, eliminatory, and generative organs. Rheumatism, gout, diabetes, anæmia, struma, and all constitutional taints, must be treated upon correct lines.

Exercise in the open air is valuable in many cases, especially when the skin trouble is caused or complicated by gout, rheumatism, or general ill-health, possibly with business worry, overwork, or anxiety. But when anæmia and debility are strongly marked, the patient should lie in the open air as much as possible, or be taken for long drives. Fatigue must be avoided. As a general rule we may recommend walking, shooting, tennis, hockey, golf, riding, etc., as useful and beneficial by promoting the activity of the skin and increasing metabolism. Excessive exercise is injurious to acne. The disease is frequently aggravated or a relapse induced by a long walk, prolonged riding, or other means of inducing great activity of the skin. Many patients who are martyrs to psoriasis while occupying a post which encourages sedentary habits or confinement to their office or house are cured by getting a post which necessitates out-of-door exercise and plenty of fresh air. A person predisposed to psoriasis may get an attack of his disease if he leads a sedentary life, takes his meals irregularly, gets indigestion, has mental worry or anxiety, is overworked, or does not allow himself needful rest and recreation. Change of air, scenery, and company are proper for such people, whereby the digestive and nervous systems are corrected, and the causes of malassimilation, defective metabolism, or debility, are removed. Change of air is not good for lupus, as many relapses have been observed after such persons have gone into a fresh locality. A similar relapse is produced in acne by visiting the South of England, the vales of Devon or Derbyshire, and similar relaxing areas; but change to high and dry places is usually beneficial.

The Mineral Waters.—A course of sulphurous waters at Harrogate, Moffat, and other places in Great Britain, or at Baréges, Aix-la-Chapelle, Enghein, Leuk, Luchon, and Kreuznach on the Continent, is very good, when combined with fresh air and scenery. It is far better to drink these waters at the spa, where they may be got perfectly fresh, than it is to drink them at home without the proper conditions for spa treatment. The chalybeate waters of Harrogate, Leamington, and other places, are very good for the debilitated; the alkaline waters of Vichy, Bourboule, Royat, Saratoga-Vichy, and other places, for those of the uric acid diathesis; that of Carlsbad for diabetes. *Baths* of these waters are very good, especially those of Leuk, Baréges, Luchon, and Kreuznach. In many cases the skin may be beneficially stimulated by Russian vapour or Turkish hot-air baths, and in numerous instances the application of massage is a useful aid to other treatment.

Electricity and electric baths are useful. The continuous current may be applied directly to diseased patches, or the interrupted current to the whole body by applying the poles to the hands, feet, or spine; it is of undoubted tonic value, especially in neurotic cases.

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CHAPTER XXIV

DIABETES

This disease occurs three times as frequently among males as females. In males it is more common from thirty to forty, but in females from ten to thirty years of age. Its cause is indefinite, its pathology obscure. The discovery that sugar appears in the urine of animals after the puncture of the floor of the fourth cerebral ventricle has thrown no light upon the subject. The disease consists of the passage of an enormous amount of urine, sometimes 20 pints a day, which contains glucose or grape-sugar varying in proportion from a mere trace up to 40 grains per ounce, but more commonly 8 or 10 grains. Ammonia is also present, sometimes in large amount. In spite of the ammonia, the urine has an acid reaction from the presence of β-oxybutyric acid, and the latter is converted by oxidation into aceto-acetic or diacetic acid, which in turn breaks up into acetone and carbonic acid. The presence of sugar is shown by examining the urine with Moore's, Trommer's, Fehling's, and other tests, or by fermentation with yeast; and diacetic acid is detected by perchloride of iron.

Many views are held as to the cause of diabetes, but objections can be raised to each of them. A few points, however, are positively known. Carbohydrate and sugar are converted in the alimentary canal into dextrose, which enters the portal circulation, and is normally stored up as glycogen in the cells of the liver. It is released from the liver by the aid of an enzyme, as it is required to supply the wants of the body. If this were not so, the system would be flooded with sugar after each meal. There is normally a constant presence of about $\frac{1}{2}$ per cent. of sugar in the blood, but this is greatly increased in diabetes. The kidneys merely filter off the excess of sugar from the blood, but have no share in the causation of the disease.

Diabetes or sugar in the urine may occur in one of the following ways:

(1) If the power of the liver to convert the carbohydrate brought to it into glycogen, or to retain it, is defective, some or all of

the sugar from the food must pass over into the general circulation instead of being stored up, just as if the glycogenic function did not exist.

(2) Glycogen is converted so rapidly by the enzymes of the liver into glucose that larger quantities pass over into the general circulation than the system can deal with, either because the liver transforms it too rapidly, or because the respiratory and muscular processes in which it is used are suspended or too enfeebled to use it up.

The relation of the pancreas to diabetes is well known. *Complete* removal of this organ causes sugar to appear in the urine, but this does not happen if the removal is *incomplete*, a small portion of pancreas being left. In rapidly fatal cases of diabetes the pancreas has been frequently found to be diseased. It is supposed that, besides secreting a powerful digestive fluid, the pancreas has an internal secretion which operates upon the liver by increasing its power to form and retain glycogen, and checking the escape of sugar.

The nervous system also has something to do with the process, for experimental puncture of the brain in the floor of the fourth ventricle causes diabetes. The central nervous system controls the bloodvessels of the liver, and governs the formation of ferments and other chemical processes.

The most conspicuous and remarkable symptom of the ailment is the evacuation of an enormous quantity of pale urine which contains sugar. If the patient really passes more liquid than is contained in his food and drink, there must be a corresponding wasting of the body. A great thirst is caused by the drainage of so much water from the blood and tissues ; the blood becomes thick, the skin and muscles get dry and shrivel up, because their moisture is drained away. Insatiable hunger is as constant as unquenchable thirst, because a large part of the food consumed escapes from the body without nourishing it at all, and emaciation must take place.

Diabetes insipidus is another form of disease in which very large quantities of urine are evacuated ; this, however, is not associated with disease of the liver or pancreas, but is probably of nervous origin. From 10 to 40 pints of urine are sometimes passed in twenty-four hours, which causes a great thirst ; whence

it is called the **drinking diabetes**, to distinguish it from true diabetes, in which eating and drinking may both be excessive. The urine in this case does not contain sugar, or, at any rate, only a trace of inosite, which many authorities consider to be a normal constituent.

The *treatment* is mainly by dietetic and hygienic rules, the first of which is that the patient should live chiefly upon animal food, and take very little starchy or saccharine material. That persons can live and their health be maintained upon a diet consisting solely of meat and water has been abundantly proved. Not only natives but Europeans in certain localities live on meat or fish for twenty or thirty years in full possession of bodily and mental vigour.[1] But the absolute prohibition of food containing starch and sugar in diabetes has been abandoned, experience having taught that, although the loss of such food might temporarily check diabetes, it would not cure it. It has also been found that very few patients can endure for years a diet consisting solely of meat, fish, eggs, crab, salad, and bran or gluten bread, which were the chief items formerly allowed. On the contrary, it relieves the patient to have a little bread or dry toast, and certainly does no material harm to elderly persons with confirmed diabetes. The treatment therefore resolves itself largely into what the patient may eat and drink, and what should be avoided.

He may have any food from the following lists :

Bread made of aleurone, soya, almond, bran, gluten,* dahlia tubers, dandelion root, or chicory ; powdered milk or casein and other starchless foods ; in certain cases a little ordinary stale bread, dry toast, Zwiebach, oat-cake, or cake made of potato.

Cream, butter, cream cheese, new milk cheese, cheese ; oil, cod-liver oil, or other fats.

Soup made of all kinds of meat, poultry, or game (*except the liver*) ; ox-tail, mutton, veal or chicken broth, mock or real turtle, snail or oyster soup ; essence of beef or other meat extract. Soup may be flavoured with mint, parsley, thyme, marjoram,

* Krause of Carlsbad asserted that of nineteen specimens of gluten bread analyzed, *only* five contained less than 30 or 40 per cent. of carbohydrate, four between 40 and 50, two from 50 to 60, and four over 60 per cent., against an average of 50 per cent. of carbohydrate in *ordinary white* bread. Collier says it is impossible to get the gluten free from starch by washing it—hence the difficulty. Its source and careful manufacture ought to be scrutinized. Pavy long ago said that diabetic gluten bread should contain 75 per cent. of gluten.

savory, bay-leaf, basil, the green tops of celery, leek, onion, shallot, garlic, ketchup, cloves, allspice, pepper; but must *not be thickened* with flour, oatmeal, maize, barley, rice, vermicelli, semolina, bean or pea flour, or any other farinaceous material.

Fish.—Fresh and salt water fish may be eaten fresh, dried, smoked, or salted, without bread or vegetables. They may be eaten with butter, lemon juice, vinegar, pepper, salt, ketchup, anchovy, fennel, parsley, and other sauces which contain *neither sugar nor starch.* Lobster and crab (excepting the inside), oysters, mussels, **snails**, shrimps, prawns, and caviare are allowed. The light kinds of fish are most suitable for delicate persons, as sardines, pilchards, anchovies, white herring, bloater, sole, plaice, turbot, brill, flounder, whiting, haddock, cod; but salmon, trout, white fish, halibut, mackerel, eel, conger-eel, and other heavy kinds, may be eaten by persons whose digestion is good.

Eggs may be eaten in any form. Cheese is recommended especially Gorgonzola, Parmesan, and other rich kinds.

Meat of all kinds is permitted **except liver**; it may consist of fat and lean, boiled, baked, roasted, grilled, or minced, and dressed with spices; poultry and game, both domestic and wild; ham, bacon, tongue, heart, brain, sweetbread, marrow bones, tripe, brawn, kidneys, calf's head, sausage, and polony (if they do not contain bread or other farinaceous material); dried, salted, or smoked meat; jelly made from meat. The following **spices** may be used: Salt, pepper, vinegar, mustard, horse-radish, cayenne, capers, parsley, fennel, dill, laurel, bay-leaf, garlic, mace, nutmeg, cinnamon, cloves, and caraway.

Green vegetables and **salads** may be eaten freely, including cabbage, savoy, kale, red cabbage, turnip-tops, spinach, beet-tops, green peas, artichokes, vegetable marrow, pumpkins, cucumber, mushrooms; lettuce picked from the stalk, endive, watercress, mustard-and-cress, sorrel, green onions, leeks, **pickles**, and enough onion or garlic to give a flavour to salad made with oil and vinegar. No sugar should be used, but saccharin is allowed if it is desired to sweeten the salad. *When very strict dieting is not necessary* we may add to the list: potatoes, especially new ones; and, in moderation, cauliflower, broccoli, brussels-sprouts, seakale, asparagus, turnips, and French beans, if they are boiled in plenty of water. Asparagus contains an amount of material which is

similar to sago, and should only be eaten in strict moderation. Artichokes only contain inulin and lævulose in the spring, but starch is present later in the year. New or unripe potatoes contain a very much smaller proportion of starch than fully grown or ripe ones. All vegetables which are blanched like celery contain a certain amount of sugar.

Fruit is allowed in moderate quantity: peaches, apricots, strawberries, raspberries, gooseberries, currants, rhubarb, cranberries, and lemons. Cooked fruit should be sweetened with saxin or saccharin, and may be eaten with cream. Invert-sugar or lævulose is recommended to sweeten the food for diabetics; 1½ ounces can be taken daily without causing increase in the excretion of sugar. The sugar in some kinds of fruit consists chiefly of lævulose. One litre of the juice of early cherries contains 83·6 grammes of lævulose, of ripe cherries 96·5, of early strawberries 45·1, ripe strawberries 100·0, of quince 75·9, of pears 85·8; 1 litre of apple juice contains 102·8 grammes of lævulose and 6·8 of saccharose; peach juice 33·5 grammes of lævulose and 19·8 of saccharose.[2]

Olives may be eaten freely; they are valuable for the oil and their aperient qualities. Nuts, such as walnuts, almonds, filberts, brazil, butternuts, and cocoanuts, may be eaten in almost any quantity. Chestnuts contain a large proportion of starch, and must be excluded from a strict dietary.

Custard, cream, whipped cream, egg-snow, jelly, savoury jelly, isinglass, and other jellies, are permitted. No sugar or starchy material must be used in their preparation, but saxin or saccharin may be used to sweeten them; and lævulose or invert-sugar may also be used up to 12 drachms a day without increasing the amount of sugar excreted in the urine.

Drink may consist of tea, coffee, any kind of cocoa free from starch and sugar, cocoa made from cocoa-nibs, lemonade or barley water sweetened with saxin or lævulose, whey or koumiss to a limited extent, soda, potash, Salutaris, Apollinaris, or similar unsweetened water. The alkaline waters of Vichy, Vals, Contrexéville, Royat, and other places, are valuable for this disease; they may be flavoured with a little lemon juice or claret. Dry sherry, dry Sauterne, Hock, Chablis, claret, Burgundy, Moselle or Rhine wine are permitted; and a little old whisky, brandy, or dry gin well diluted with water or alkaline water.

Forbidden.—It is in most cases forbidden that the patient should have sugar or starch in the form of bread, pastry, suet puddings, and farinaceous foods, such as oatmeal, barley, maize, rice, sago, tapioca, arrowroot, cornflour, macaroni, vermicelli, semolina, or revalenta—that is to say, all ordinary puddings, as well as pastry and bread, are forbidden. **Jellies** which contain sugar or fruit are also forbidden. Liver, oysters, mussels, cockles, and the *interior* of crabs and lobsters, are unsuitable because they contain glycogen: some of the shellfish have enormous livers. Sausages and polonies which contain bread are to be rejected. All **sweet fruit** contains dextrose and lævulose. The former increases the sugar in the urine; therefore nearly all fruits (except those allowed in the above list), whether fresh or preserved, must be rejected—*e.g.*, jam, marmalade, preserved ginger, guava jelly, chutney, grapes, figs, dates, oranges, melons, pears, cherries, mulberries, plums, and damsons. Chestnuts, pea-nuts, and ground-nuts contain starch. Potatoes, carrots, turnips, parsnips, beetroot, tomatoes, Spanish onions, green peas, kidney beans, broad beans, asparagus, artichokes, are all rich in starch or sugar. All **blanched vegetables**, such as cauliflower, broccoli, celery, endive, seakale, onions, and the white stalk of lettuce and cabbage, contain sugar, and are forbidden in most cases. **Malt liquors**, as beer, stout, porter, lager beer, **sweet wines**, such as port, Madeira, Marsala, champagne, and liqueurs, all contain sugar, and are therefore forbidden. Lemonade and other aerated drinks are also sweetened with sugar or syrup. Starchy or sweetened cocoa, milk, except a small quantity for tea or similar drinks, and whey or koumiss, are all forbidden in very strict dieting.

The feeding of a diabetic patient is not such a simple matter as it may appear. Lists of allowed and forbidden articles are given, and will be found to be extremely useful, but each case requires very careful consideration, and no possible list can be given which is applicable to all. Lorand of Carlsbad, who has devoted much attention to this subject, considers that it is quite as necessary not to overload the patient with nitrogenous material as it is to avoid giving too much carbohydrate; that it is not necessary to entirely suspend the supply of starch and sugar; that the personal equation must be taken into account. We know that

abstinence from starch and sugar will in most instances result in a reduction of the amount of sugar excreted and of the volume of urine, with a corresponding arrest of emaciation, and probably a gain of flesh or general improvement. Rigid exclusion of starch and sugar is not always necessary,[3] but to ascertain what foods may be allowed certain observations are recommended by Von Noorden[4] and others. The patient is first tested with a known quantity of his ordinary food for three days, during which the output of sugar is carefully estimated. A comparison of the amount of carbohydrate consumed with the sugar excreted in the urine will show how much carbohydrate may be taken without any appearing as sugar in the urine.

He is then tested with a purely animal diet for three days, and the excretion of sugar again calculated. Now, 100 grammes of proteid are capable of producing 40 grammes of sugar, whence we learn how much proteid can be taken without increasing the sugar. If more than 40 grammes of sugar are excreted for every 100 of proteid consumed, it must be derived from his body, and shows a very grave condition. When, however, *no sugar* appears in the urine with animal diet, we may experiment with 20, 50, or 100 grammes of carbohydrate a day, stopping as soon as sugar appears. The amount of carbohydrate which can be taken without causing any sugar may be continued regularly.

The excretion of urea must also be watched. An excess of proteid food throws much work on the eliminating organs, and might be as injurious as carbohydrate if its excretion were imperfect. Attacks of indigestion or gastric crises must also be guarded against. Overfeeding is as bad as malnutrition.

A weekly record of the patient's weight, output of sugar and urea, should be kept as a guide to the food which may be allowed. The diet should be sufficient to maintain a nitrogenous equilibrium, the urea excretion being neither more nor less than the consumption of proteid will explain, and sugar excretion must be kept down by a proper control of both carbohydrate and proteid food. There should be an endeavour to increase the weight, or at any rate prevent emaciation. If, in spite of a rigid diet, the excretion of sugar persists or goes beyond the amount which can be accounted for by the food, a very strict dietary is inadvisable, and some carbohydrate should certainly

be allowed. Strict dieting is also unnecessary in cases of confirmed diabetes, which is indicated by the presence of diacetic acid in the urine. The younger the patient, the more serious is the outlook; on the other hand, elderly people with confirmed diabetes in a moderate degree may live for many years. When the sugar which is excreted is derived from the food and the patient's weight remains constant, the condition is not very serious; the patient may die from some other disease, and not as the direct result of diabetes.

Certain technical considerations may be of use in constructing a diet chart. An individual expends from 35 to 45 calories per kilo of body-weight, and a man of average weight from 2,610 to 3,625 calories per day. Therefore, if the weight remains constant but 100 grammes of sugar having a calorific value of 4 are being daily excreted in the urine, 400 calories are received too much or in excess of the requirements, and the consumption must be reduced. Now, it is established that 1 gramme of sugar yields 4 calories, starch 4, fat 9, albuminoid 4, and alcohol 7; and bearing these figures in mind while arranging the dietary, we may vary it much more than was formerly thought possible, according to the output of sugar and urea.

Carbohydrate food, especially bread, cannot be allowed *ad libitum*, because of the starch in it: whole wheat-meal contains 70 per cent. of starch, superfine white flour 75, and oatmeal 67; gluten bread always contains 25, and sometimes 35 to 40 per cent. Almond, soya, and other diabetic bread, cake or biscuits contain an indefinite quantity of starch, partly from the use of wheaten flour to assist in panification; indeed, no diabetic bread which is palatable is safe to use when bread is a forbidden article.

Toasted bread is sometimes allowed to the extent of 2 or 3 ounces a day; the starch in it is converted to dextrin by proper treatment, and is thereby more readily assimilated. **Sachse** gives the following directions for making toast: The bread should be thoroughly dried in an oven at a temperature of 400° F., which is the proper dextrinizing heat. Such toast is crisp to the centre and brown on the surface; it has an agreeable toast flavour, is easily broken, quickly moistened by the saliva, and has the advantage of not being able to be swallowed without careful mastication. Unless bread is properly treated the toast is liable to be sodden,

boggy, discoloured, rolls into pellets during mastication like new bread, and has no advantage over new bread in any degree.

One of the greatest modifications in the dietetics of diabetes arises from the introduction of potato into the diet by Professor Mossé, who considers that the tuber contributes to the cure of the disease by the salts of potassium which are contained in it. This opinion is confirmed by other eminent observers. It was formerly common to allow bread even when potato was forbidden. But this was irrational, for ordinary bread contains 48 or 50 per cent. of starch, and gluten bread 25 to 35 per cent., while ripe potatoes only contain 16 to 24, with an average of 22·7 per cent., and *new* potatoes even a less proportion of starch than ripe ones. If we allow $\frac{1}{2}$ pound of potato three times a day the patient will get 681 grammes, containing 150 grammes of starch; but the same amount of bread would contain 330 grammes of starch. It is therefore more rational to begin with potatoes. They can be eaten alone or with meat, made into cake or bread, used to thicken soup or make a purée, and in various other ways. They are lighter when cooked in their skins than any other way, and then do not lose any of their salts. Sir J. Sawyer gives[5] the following recipe for making cake or bread: Let the potatoes be steamed in their jackets twenty-four hours before using them; break them into flour with the fingers. Take 1 pound of potato flour, $\frac{1}{2}$ pound of bran, 1 ounce of German yeast, 1 ounce of butter, two eggs, and sufficient water; let all the ingredients be mixed together and into a paste of proper consistency, set it before the fire for an hour to rise, and bake in a greased tin for one and a half hours. An improvement is made by mixing the ingredients with an infusion or decoction of bran instead of ordinary water.

Oatmeal has been tried with success in the treatment of diabetes; it contains 10 per cent. less starch than wheaten flour, but is rich in proteid, phosphates, and iron; it can be made into oat-cakes, porridge, or soup, and eaten with cream or sweetened with lævulose. Von Noorden[6] says that oatmeal combined with a simple albuminous substance, such as casein and butter, in the proportion of oatmeal 5, albumin 2, and butter 6, will free the patient from diabetes; and as the sugar in the urine diminishes, the ammonia and acetone will also disappear. Seigil agrees[7]

with this; and Mohr asserts that oatmeal is the best diet, not only for diabetes, but for all acid auto-intoxications.

Robin[8] says that in this disease there is an increase of the chemical changes in the liver cells and of the nutrition in general, which results in increased activity of the nervous system. Because of the great loss of mineral salts thus induced, he recommends plenty of salt to be eaten with the food; also green vegetables, particularly cabbage and endive, to supply potash salts; a weak solution of cream of tartar to be drunk with wine at the meals; and soups, on account of the inorganic salts in them.

Milk is allowed to the extent of several pints a day by some authorities. Roberts said it was less deleterious than might be supposed; the patients gain weight under its use, but the excretion of sugar is increased to some extent. Von Noorden also allows milk in some cases, and finds the general nutrition increased by it. Donkin prescribed *skimmed* milk largely for his patients, beginning with 4 pints and increasing it to 12 daily; it agrees well with some, but is badly borne by many patients. Other physicians (Germain Sée, Frierichs, Bouchardat, Dujardin-Beaumetz, etc.) *exclude* milk from the dietary entirely, on the ground that the sugar of milk (lactose) is injurious. Voit and others have investigated the matter closely, and proved that the lactose is consumed in the body; but as it spares the consumption of sugar arising in these cases from proteid metabolism, a large portion of the latter is unburnt and readily passes into the urine.[9] Milk would therefore be good for the patient if the lactose were removed, and Martindale formulated the following method of doing so: $1\frac{1}{2}$ pints of milk is mixed with $1\frac{1}{2}$ pints of water, and curdled with 90 c.c. of a 30 per cent. solution of acetic acid; the curd is allowed to settle, and is then removed and washed on a filter. It is then rubbed up in a mortar with some calcium carbonate, and water is added to again make $1\frac{1}{2}$ pints; the curd is thus dissolved. The liquid is allowed to stand for some time for the lime to settle out of it, and is then decanted and sweetened with 2 per cent. of glycerine.[10] There are, however, various preparations of casein on the market, and if one is used which does not contain sugar, it may be made a ready means of supplying milk albumin in a suitable form.

The Yolk Cure.—The occurrence of acetone in the urine is a sign of under-nutrition and a signal to relax the rigidity of the diet; indeed, acetonuria sometimes occurs as the result of a prolonged meat diet or from the too close exclusion of carbohydrate. So long as nutrition is well maintained acetone does not appear in most cases; but when it does occur, it may be followed by coma. In this state of things it is usual to allow a little carbohydrate, some alcohol, and not so much meat or other albuminous food. Acetone appears in the urine as a result of the destruction of fat, which is taken in the food or derived from the body by emaciation.[11] The chief substitutes for carbohydrate are butter, cream, and fat meat. Fat of a low molecular value, like butter and cream, yields fatty acids which are injurious.[12] Stern says the only fatty article which may be taken in large amount without giving rise to fatty acids of low molecular value is the *yolk* of hen's egg, which never causes the production of acetone. He prescribes the yolk cure for acetonuria; it consists in taking the yolk of ten to forty eggs a day with some proteid and green vegetables. The yolks may be taken raw or cooked in various ways for a long period, the ordinary diabetic diet being discontinued while this is in use. A large amount of fat in the food of diabetics is beneficial to them, but it increases acetonuria; the latter, in fact, does not diminish until the quantity of fat, especially butter and cream, is reduced.[13]

The Yeast Cure.—Cassaët[14] recommends a tablespoonful of brewer's yeast or 36 grains of dried yeast three times a day. The immediate effect of this remedy is the expulsion of much flatus, followed by fœtid diarrhœa in two or three days. Tolerance is soon established, the sugar in the urine diminishes, weight increases, and the general condition improves. It is readily taken by some people, but others greatly object to it. Roos and Huisberg[15] have analyzed the dried yeast, and find it contains 3 per cent. of neutral fat, some free fatty acids, a little cholesterin, and a very small proportion of an essential oil. From their experiments they consider that the beneficial effect of yeast is due to the neutral fat, which is now obtainable in a separate form.

Linseed tea has also been of service in some cases of diabetes. Vogel[16] prescribed it in 100 cases with excellent results, the ordinary dietetic rules being observed. A tablespoonful of linseed

is boiled in about $1\frac{1}{2}$ pints of water for a long time and strained; it should be taken during the day in four doses, each being taken before a meal.

Alcohol in Diabetes.—All sweet wines, port, champagne, Sauterne, beer, and other malt liquors are to be strictly avoided; also strong alcoholic liqueurs. All light wines which are free from sugar may be allowed: still Moselle, Hock, claret, or good Burgundy, with or without soda-water; also unsweetened spirits—brandy, whisky, gin—if well diluted. The average daily consumption of alcohol should be limited to 3 or 4 ounces of brandy or whisky, or half a bottle of Moselle or Burgundy. In moderate quantity it has no ill-effect as regards the diabetes; it is a foodstuff of moderate caloric value, and sometimes improves the general condition. The state of the heart, vessels, and kidneys must be borne in mind, and alcohol must be allowed with great caution where these are diseased.

Gouty Diabetes.—In certain persons a condition of suppressed or undeveloped gout occurs along with the symptoms of diabetes. They are usually people of large frame, perhaps fat and flabby, with little stability or power. They are frequently energetic persons, but are readily exhausted. They have a large appetite, are pale, and suffer from coldness of the extremities. They are drowsy by day, but sleep badly at night; have attacks of giddiness and a feeble action of the heart. Their urine varies in colour and specific gravity; but it contains sugar, and usually some albumin or uric acid. These people cannot be strictly dieted either for gout or diabetes; if they are strictly dieted they go from bad to worse. They should be carefully but liberally fed with meat, game, poultry, or fish, together with **ordinary bread and vegetables.**[17] They may have a little well-matured wine or dry champagne, but its effect must be carefully watched. The sugar and albumin will disappear under proper treatment, the urine become normal, the heart gain in strength, and the general nutrition and health be improved.

The alkalies and alkaline waters hold a deservedly high place in the treatment of diabetes. Their administration causes a general improvement in the condition of the patient, with a disappearance of acetone and sugar from the urine. They are especially recommended to be used when a patient is being

transferred from ordinary diet to one which is poor in carbohydrate, or when he is taking a rigidly diabetic diet.[18] The only contraindication to their use is very rapid emaciation of the body, when they may possibly be prejudicial. The bicarbonates of sodium and potassium have a very beneficial effect, and the alkaline waters of Vichy, Carlsbad, and Neuenahr or other places have been drunk with great success. A course of waters at these springs extending over several weeks results in an abatement of thirst, a decrease in the amount of urine passed, frequently a total disappearance of acetone and sugar, and a corresponding tolerance of carbohydrate food and a gain in weight. All alkaline waters are beneficial, whether drunk at their source or in the patient's home. They reduce the output of sugar by checking the transformation of glycogen into this material; and even when the disease is of pancreatic origin they keep down excessive sugar formation and prevent the harmful effects consequent upon it.

As in all other cases of invalidism, the patient must be warmly clad to prevent chill, especially as there is a predisposition to pneumonia. He must have rest of mind and body, being occupied merely with a light task to prevent ennui. He must live in healthy rooms in a suitable locality, and take moderate exercise daily in the open air.

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CHAPTER XXV

BRIGHT'S DISEASE

Sufferers from Bright's disease are frequently individuals in middle age—at that period of life when a man's best work and most valuable results are produced. The importance of its early

recognition is therefore evident, and its proper hygienic and dietetic management is paramount. Dr. Bright was the first who recognised disease of the kidneys as being associated with general dropsy and albuminous urine. He found in death from this ailment that the kidneys were either large, pale, and smooth, or they were small, dark, and granular, which he regarded as two stages of the same disease. Later researches, however, showed that there are two different forms of it. In the first the inflammatory process affected the tubules, whence it is called chronic tubular nephritis; in the other form the intertubular tissue is primarily affected, whence it is called chronic intertubular nephritis. Some symptoms occur more or less in both forms—*e.g.*, albumin and casts in the urine, changes in the heart and bloodvessels, sometimes an excess of urea in the blood, blood in the urine, hæmorrhage, changes in the eyes, and secondary diseases.

In an **acute attack of Bright's disease** the tissues of the kidneys are affected in various degrees. One of its most prolific causes is exposure to cold; but scarlet fever, diphtheria, and other febrile diseases, pregnancy, and various drugs or chemical agents, will cause it. However it is induced, the chief symptoms are diminution in the amount of urine; a sediment, albumin, and tube casts in the urine; pain in the back, headache, fever, and other signs of being acutely ill. Dropsy soon appears. First the face swells, then the feet and ankles, and it speedily becomes general. Sometimes dropsy is the first symptom which is noticed, and an examination of the urine reveals the others.

The treatment of this acute form is very important, because when it is neglected it degenerates into one of the chronic varieties. In the normal condition of the body the skin assists the kidneys to excrete the waste nitrogenous materials. Our first duty, therefore, is to urge the skin to temporarily take some of the work off the kidneys, to increase the share in the partnership. We can do this by inducing free perspiration, which would rid the system of the accumulating débris, and relieve the congestion of the kidneys by drawing the blood to other parts of the body. Various methods of doing this are adopted—*e.g.*: (1) Let the patient be given a **hot bath** at about 100° F. for thirty to sixty minutes, during which time the temperature of the water is kept up by removing some of the cool and adding more hot water.

When the patient is taken out he must be quickly dried, clothed in a flannel gown, put to bed, wrapped in the blankets, and other clothing thrown over him to encourage the perspiration. (2) A **wet pack** is useful for the same purpose. The body is wholly wrapped, excepting the head and face, in a double blanket wrung out of nearly boiling water, to which 2 or 3 ounces of mustard (made into a paste) have been added. He is covered with more blankets for about two hours, after which he is quickly rubbed dry with warm towels, and put to bed again in warm, dry blankets. (3) A **Turkish or Russian bath** may be used for the same purpose if it can be done at home. Yeo[1] gives the following directions for a simple **hot-air bath**: With the patient in bed, place a spirit-lamp on a box or chair at the foot of the bed, and fix over it a funnel, to which is attached a tube bent at right angles and of sufficient length to pass under the bedclothes. The heat given off by the lamp and the steam caused by the combustion of the spirit is usually enough to throw the patient into a profuse perspiration. The clothes should be tucked in around the patient's neck to keep in the heat. A simple **vapour bath** can be given as follows: Make two bricks hot in a fire; have ready a cane bottom chair with a piece of flannel upon the seat. Place a bucket of boiling water under the seat. The patient, being undressed, sits down; one of the hot bricks is put in the water, and a blanket or two is used to envelop the chair and the patient. After ten minutes the brick is removed from the water and another hot one put in it. A profuse perspiration can be kept up in this manner for twenty minutes; then dry the patient quickly with warm towels, place him in bed between dry blankets, and cover him with clothing to encourage the continuance of perspiration.

Various local measures may also be used to assist in relieving the congestion of the kidneys. Hot mustard poultices applied to the loins and changed frequently are very efficacious counter-irritants. A thick layer of cotton-wool over the same region makes a dry poultice which soon becomes hot, because it is a bad conductor of heat from the body, and is a far better application than poultices.

Purgation assists to relieve the congestion of the kidneys, and removes from the system some of the nitrogenous waste and poisonous materials. The result of neglecting treatment at this

stage would be an accumulation of the waste products in the body, which might induce uræmia and convulsions, with possibly a fatal termination.

The Diet.—We must be careful not to add any more to the accumulated waste products by means of food. We must therefore enjoin rest in bed to reduce the work of the machinery to its lowest point, and exclude from the food such materials as will introduce nitrogenous waste. The food should therefore consist of milk, buttermilk, whey, barley-water, oatmeal-water, thin arrowroot or oatmeal gruel, apple-water, black-currant water, lemonade, or imperial drink. All food should be taken warm. The free use of liquids is necessary to supply the water required to encourage perspiration on the one hand, and to wash out the débris from the tubules of the kidneys by flushing them. Milk may be taken to the extent of 3 or 4 pints a day. It supplies the albumin lost by the kidneys and the requirements of the body, and, like oatmeal and barley, it is soothing to the kidneys and diuretic. Milk should not be drunk in bulk, but in frequent sips; each tumblerful may have added to it a little bicarbonate of potash or soda, or an alkaline water, by which heaviness and vomiting may be prevented.

Whey can be made by boiling a pint of milk with the juice of one lemon or an ounce of tamarind; strain it. **Imperial drink** is made by pouring a quart of boiling water over two teaspoonfuls of cream of tartar with the juice and pulp of a lemon; strain and sweeten it.

Apple-water is made thus: Wash four firm apples, cut them in slices without removing the peel; put them into a saucepan with two tablespoonfuls of sugar, three or four cloves, and 2 pints of water; boil ten minutes; strain when cool.

Barley-water is made thus: Boil 2 ounces of pearl barley in a pint of water for five minutes; pour away the liquid and wash the barley; then put the barley in a quart of boiling water with the rind of a lemon cut in slices; let it simmer for two hours, add the juice of the lemon, sweeten it, and strain when cold.

Oatmeal-water is made in a similar manner with coarse oatmeal.

Vomiting is sometimes very troublesome, but may usually be relieved by a mustard plaster put over the pit of the stomach, small pieces of ice to suck, or lime-water and milk to drink. The

patient, however, may be nourished, if necessary, until the sickness ceases by enemata of peptonized milk and egg, and injections of 20 or 30 ounces of water into the bowels several times a day.

After a few days we may add farinaceous foods, biscuit, bread, milk pudding, and a little stimulant, such as tea, coffee, or cocoa, but no alcohol. With progressive convalescence the urine must be watched, for no meat can be permitted until it is free from albumin. As the symptoms subside we may allow a little mutton or chicken broth ; then steamed sole, plaice, brill, turbot, whiting, or haddock ; and when the albumin has quite disappeared, a little chicken, a poached or boiled egg, or beef-tea ; and beef or mutton may be eaten in two or three weeks from the commencement. Fish may be accompanied by a little mashed potato, squash, vegetable marrow, or spinach, and followed by stewed fruit ; and when we arrive at meat we may add kidney beans, cauliflower, cabbage, lettuce, watercress, and fresh ripe fruit.

The patient should be clothed when he gets up in woollen under-garments of thickness proportionate to the season, and must carefully avoid exposure to cold and damp.

Chronic Bright's Disease.—The causes of subacute or chronic Bright's disease are more or less obscure, except when it follows an acute attack. The disease often comes on so insidiously that it would be difficult to fix the exact date of its commencement. Among its causes we may mention frequent exposure to wet and cold, especially a combination of the two, which lowers the vitality, checks the functions of the skin, and throws back upon the kidneys the waste materials which it ought to eliminate, by which means the kidneys are irritated and subjected to a long course of chronic inflammation. Sometimes it follows the acute disease, especially that form which is the result of scarlet fever or diphtheria. More often, however, the chronic disease is the result of long-continued irritation of the kidneys. This is due to the constant presence in the blood of a small portion of some irritating material or poisonous substance—not enough to produce poisonous symptoms—which causes a change in the structure of the kidneys. The poison of gout is one of these substances. Its presence is most easily ascertained, and it is one which may continue to act with a slight intensity over a very long period. Uric acid is believed to be that substance, and its presence in the

blood will irritate the kidneys. There is a remarkable fact in connection with this—viz., that when the joints are affected by gout the kidneys are usually more or less free, so that a man who has much gout in his joints may be thankful that his kidneys will probably be spared. Other blood poisons which affect the kidneys are malaria, tuberculosis, lead, alcohol, and those which are the result of free and irregular living, of pleasure rather than labour. The long-continued irritation of the kidneys by alcohol or its oxidation products in the blood is an example of how a small portion of poison, which acts with slight intensity over a prolonged period, may produce Bright's disease. *Free* indulgence in this stimulant is very likely to cause it. That disturbances of the metabolic processes of the body over a period of time are likely to cause Bright's disease is a theory which receives the support of many pathologists. The function of the kidneys is the elimination of the utilized and unutilized proteids from the body. Utilized proteid is that portion of nitrogenous food which has been assimilated and become for the time being a part and parcel of the body. Unutilized proteid is that which is absorbed from the alimentary canal in excess of the requirements of the body, and any proteid which is absorbed in a form unsuitable for organization, as the purin bodies. Porter gives three causes of Bright's disease associated with the food: (*a*) Deficient oxidation of nitrogenous material due to an insufficient supply of oxygen, or taking in more than the body can negotiate. The tension in the bloodvessels is raised by the presence of purin bodies in excess, and these substances irritate the coats of the vessels, whereby such changes are produced as may be a forerunner of kidney trouble. (*b*) The production of abnormal substances in the alimentary canal. (*c*) The presence of microorganisms. With regard to the first, as Porter says,[2] so long as the work of the kidneys is not too great, and the supply of nutriment is of the right kind, quality, and quantity, the kidneys will maintain their integrity. But if the supply of oxygen is insufficient, or the system is unable to completely oxidize the amount of proteid ingested, a portion of it will be excreted as albumin by the excretory cells of the kidneys, and there will consequently be a reduction in the output of urea and an increase of uric acid. A careful study of the urine as regards the output

of urea, uric acid, and albumin is necessary to show whether the kidneys are perfect or imperfect. If the albumin in the urine is only a transitory matter there may be no disease of the kidneys, but it indicates that such disease will soon occur if the abnormal condition which induced it is not corrected. With regard to the second, putrefactive changes occurring in the alimentary canal result in the formation of toxic materials which have to be eliminated—*e.g.*, indican is formed by proteid fermentation and appears in the urine. Micro-organisms introduced into the body with the food or otherwise produce toxic materials which the kidneys have to get out of the system, and by which the kidneys are irritated. Excessive work is thrown upon them, and the general nutrition is disturbed and a lowered tone of the body is induced. It is therefore to be inferred that Bright's disease may result from long-continued errors in the dietary, insufficient supply of oxygen owing to bad ventilation of the rooms, sedentary occupations, insufficient exercise in the open air, and unhygienic surroundings, which probably explain some of those instances of Bright's disease which cannot be traced to definite causes, in which we can only be sure that the patient must have been subjected for a long period to some influence of a deleterious nature. So insidious and prolonged is occasionally the course of the disease that the most serious permanent changes may have taken place in the structure of the kidneys before any prominent symptoms occur to call attention to them. Mental and emotional causes, prolonged anxiety, worry, business or family cares, and sometimes the trials and difficulties of religious life, are sufficient to produce through the nervous system such disturbances of assimilation or elimination and vast changes in the kidneys.

The large white kidney is due to chronic inflammation of the tubules of the kidney, and chiefly affects people from thirty-five to fifty years of age. The small dark or granular contracted kidney is due to chronic inflammation inducing an increase of the intertubular tissue, which contracts and causes a degeneration or destruction of the tubules. The disease may begin in middle life, but is most often met with from fifty to sixty-five years of age or later.

A person with a large white kidney suffers a good deal of pain in the loins, and passes less water than usual. Sometimes 'bags'

appear under the lower eyelids, or the eyelids are swollen as the first sign of dropsy, which increases until it becomes general. Languor and debility increase; anæmia becomes apparent by the pallor of the skin, shortness of breath, and palpitation; albumin and casts appear in the urine. The tension in the bloodvessels is increased; they become thickened and lose their elasticity, and are elongated and tortuous. These changes involve more work upon the heart, in consequence of which it becomes enlarged and its valves sometimes diseased.

The form of Bright's disease with small contracted kidneys is rarely met with until after middle life. The disease is very insidious, and the sufferer seldom seeks medical advice until some complication compels attention to it. He gets thin, weak, and anæmic without apparent cause; suffers from dyspepsia, loses his appetite and vivacity, has nausea or occasional attacks of vomiting, and his eyesight becomes impaired. An inquiry elicits the fact that he is passing more than his customary quantity of water, which, on examination, is found to contain less urea than normal, with perhaps a scanty deposit, a few hyaline casts, or a little albumin—less than 0·5 per cent. There may be puffiness of the eyelids or ankles, but as a rule very little dropsy. The bloodvessels are thickened, tortuous, and distinctly visible in exposed places. The heart is enlarged; and there is a tendency to nervous disorders, bronchitis, pneumonia, and hæmorrhages.

The significance of albumin in the urine of a middle-aged person is so important that it ought not to be overlooked. It is a constant sign of Bright's disease of the large white variety, in which it forms from 2 to 3 per cent. of the urine, and the daily loss equals 100 to 400 grains. It may be present in the urine in other diseases of the kidneys and urinary organs, in disease of the heart and lungs, or in other chronic disorders, and temporarily as a result of indigestion. Of more decisive importance are the casts in the urine. Hyaline is the basis of all casts from the kidney; it consists of a coagulable proteid material which has transuded through the tubular structure, and indicates a pathological lesion of the same. Casts may consist of hyaline alone, or combined with granular materials or cells shed by the tubules. Small hyaline casts, which are few in number, and occur in the urine without albumin in a person of forty-five or more years of

age, need not be considered of very special importance. But if they have a granular appearance or epithelial cells upon them, they are considered to be a certain sign of kidney disease. Large hyaline casts in the urine of men of strenuous business habits may be a sign of the granular contracted or intertubular form of Bright's disease, and if they are constantly present, with a trace of albumin and a diminution of the urea output, our suspicion should be excited almost to the point of certainty.

The Dietetic and Hygienic Management.—We have in Bright's disease a malady which, if neglected, can only have a fatal termination; on the other hand, by careful attention to the mode of life, to the diet, and relief from worry and anxiety, much can be done to ameliorate the symptoms, and in most cases to put off the evil day to a more or less indefinite period. Disorganized tubules can never be replaced, nor excessive intertubular tissue removed or new renal tissue formed; but the urine may be free from albumin and casts for years, and the disease be practically cured. There may be exacerbations and remissions. So long as dietetic rules are followed the remission will last and the patient be considered cured; but a relapse into former habits, a recurrence of the cause, or a fresh cause, may bring about an exacerbation. In many instances there must be a complete revolution in the mode of life, the diet, clothing, hours, and general conduct. In every case where such exist habits of intemperance must be given up, irregularities remedied, late hours abolished, exposure to all kinds of bad weather abandoned; in a word, life must be conducted in a mild and regular manner, as free as possible from turmoil, worry, and excitement.

The Dietary.—(*a*) Sometimes a purin-free diet is essential, when it may consist of 4 or 5 pints of milk daily; this may be taken alone, or in combination with tea, coffee, cocoa; in milk puddings of sago, rice, tapioca, semolina, vermicelli, or macaroni; with oatmeal, maize-meal, biscuit powder, and in the form of blancmange, milk jelly, and soup. Cream, cream cheese, new milk cheese, and cheese may be eaten. The patient should have plenty of fat in the form of butter, cream, salad oil, fat ham, bacon, or other easily digested fat. A little bread, biscuit, or dry toast may be eaten; also jellies of all kinds, calf's-foot or fruit jelly; potatoes, cooked vegetables, fresh salads, and fruit. If the milk is 'heavy

upon the stomach' or otherwise disagrees, it may be diluted with one-third of water and have a quarter of a teaspoonful of common salt in each tumblerful to aid its digestion. Milk soup may be made by boiling in it various flavouring agents, such as celery, mint, savory, parsley, or by the addition of a vegetable purée.

(*b*) When meat is not excluded from the dietary we may allow 3 or 4 ounces a day of butcher's meat or fish (sole, whiting, plaice, brill, turbot, haddock, or cod; occasionally a little salmon, trout, mackerel, halibut, or skate); the white flesh of chicken, pheasant, or game. The patient *may not have* liver, spleen (milt), kidneys, brain, or sweetbread, because they contain an excess of nucleo-albumin and purin bases which would irritate the kidneys; and beef-tea, strong soups and broths, or extracts of meat, contain a large amount of nitrogenous materials, some of which are purin bodies, in such a form that they are quickly carried to the kidneys and intensify the irritation.

Great difference of opinion is expressed by modern writers on the dietary for Bright's disease, although all are agreed that there is no disease in which the manner of life and the kind of food so largely influence its course. It was formerly usual to forbid meat and eggs in the large white or tubular form of the disease, but to allow them in moderation in the intertubular or contracted kidney; there was an almost general agreement that meat is harmful and milk beneficial. Recent authorities, however, lay little stress upon the importance of excluding meat. The observations of Voit and Pettenkofer[3] tend to show that nitrogenous food does not cause albuminuria in ordinary cases, and that its accidental occurrence is rather due to a personal factor. Osler says, under the chronic tubular form, 'Milk and buttermilk should be the chief food;' and under the interstitial or contracted form, 'The diet should be light and nourishing, and the patient warned not to eat excessively, and only to take meat once a day.' Delafield says: 'As regards diet, the sugars and starches should be restricted, the ingestion of fat encouraged, the use of wine, spirits, and tobacco discontinued.' Some writers allow fish and white meat, but forbid red meat and game, or dark-fleshed fare. Klemperer prefers fish to meat; Bouchard forbids fish on the ground that it contains toxins and increases the toxicity of the blood and urine; Pel says we should distin-

guish between the kinds of fish, but says there is no reason to exclude light and easily digested kinds.[4]

Red or dark meat is considered more harmful than the white flesh of chicken, pheasant, turkey, or rabbits. Game generally has been condemned; but nobody has explained why the dark flesh of hare, venison, partridge, quails, or other wild birds is more harmful than that of chicken to the kidneys, except that they belong to dark-fleshed fare. Von Noorden says the distinction between light and dark flesh so far as they affect the kidneys is a myth; for the amount of extractives in red and white meat are about the same, the excess being in the white, but the difference is so trifling as to be of little consequence.

Brain, sweetbread, milt (spleen), kidneys, and liver, are all condemned, because of the large amount of nucleo-albumin and extractives they contain; and the flesh of *all young* animals is rich in nucleo-albumin. Nucleo-albumins are compounds of proteid and nuclein; nuclein is the chief constituent of cell nuclei, and when decomposed yields the alloxuric or purin bodies which are chemically allied to urea, and are deleterious. Von Noorden and others have shown that normally the kidneys transform the purin bases into uric acid for elimination, and we also know that uric acid is a product of imperfect oxidation of proteid substances in the body. For this reason most authors forbid substances containing nucleo-albumin. They are contained not only in brain, sweetbread, spleen, kidney, and liver, but in the muscle cells of all young animals, such as veal, chicken, pheasants, and rabbit, which are almost equally injurious to the kidneys.[5] From this circumstance Von Noorden concludes that white flesh is no more suitable than red or dark flesh; that if one is to be allowed the other may be, or both must be excluded. There is, however, always the question of digestibility to be considered, and on this point the ballot is decidedly in favour of fish, chicken, pheasant, rabbit, and boiled mutton, *as against* veal, pork, beef, hare, venison, partridge, and dark game generally.

Eggs are excluded from the diet by some writers and permitted by others. Senator found that a lasting albuminuria was caused in animals by the injection of egg-albumin into their veins; and several other observers state that albuminuria is caused in men by eating largely of raw eggs, for which reason they have been

excluded from the dietary of Bright's disease. But Brunton and Macguire failed to produce albuminuria in people by giving them large quantities of raw eggs and egg-albumin. When we add to this fact the consideration that eggs contain casein and vitellin, which are pseudo-nucleins, differing from true nucleins in not yielding purin bodies, as well as iron, organized phosphates, and phosphates, which are so valuable for persons with Bright's disease, it may be concluded that they may be allowed with much greater safety than any kind of meat, bird, or fish. Oertel, Brunton, and others allow them; and even Senator permits them, saying that his experience did not bear out his former observations. It appears, therefore, that the clear indication is to give easily digested proteid foods, such as are the least liable to increase the nitrogenous waste, and would not add to the amount of purin bodies or tax the kidneys to excrete them.

Exclusive milk diet is a successful method of treatment. The advantages are that it contains no refuse, contains very little nucleo-albumin, and is practically free from purin bodies. It is very easily digested, its lactose is diuretic, its components are not irritating to the kidneys, it does not introduce toxic materials into the system, but tends to eliminate those already found in the body. Skimmed milk is preferred by some authorities; both it and buttermilk may be taken to vary the monotony. It is feared that an absolute milk diet is more often prescribed than followed. Nevertheless, milk should be taken as freely as possible by all the patients, thinning it when it seems desirable by the addition of one-third of water and 20 grains of salt to each pint. Some milk may be used in the form of soup, junket, milk jelly, custard, cream cheese, new-milk cheese, tea, coffee, and cocoa. But an exclusive milk diet is not well borne by many people. Its disadvantages are too much water, too much albumin, too much phosphoric acid, and too little iron for the needs of the economy (Pel).[6] Its continual use may be followed by an increase of adipose tissue, which is most undesirable in Bright's disease. A decrease in the hæmoglobin, which is so important a constituent of the red blood cells, may also result, especially when the patient has a tendency to obesity or anæmia. Three litres ($5\frac{1}{4}$ pints) of milk contain 115 grammes of proteid, 160 of carbohydrate, and 110 of fat, and will yield 2,183 calories or

units of heat, which requires to be supplemented by 50 grammes of carbohydrate to obtain the total amount of calories required daily by an average man. Now, 115 grammes of proteid will yield 38 grammes of urea, which is more than the average excretion of urea by a man doing ordinary work, and we have been cautioned against an excessive consumption of proteid in these cases. The amount of phosphoric acid in that quantity of milk varies from 3 to 4 grammes, and, according to Vaughan and others, such an amount is harmful to the kidneys. Von Noorden suggests the elimination of the phosphoric acid by adding lime-water to the milk, which converts it into an insoluble phosphate which passes through the bowels.[7] Deficiency of iron can be made up by medicine. Even then the amount of water is harmful, especially to persons with contracted kidneys, in whom the drinking of so much milk does direct injury by increasing blood-pressure, watering the blood, and throwing extra work upon the heart; and the excess of liquid acts as an unnecessary and undesirable irritant to the kidneys. For these reasons the consumption of milk should be limited to $2\frac{1}{2}$ pints, or not more than $1\frac{1}{2}$ litres, a day in the contracted kidneys, and in other cases where the amount of urine secreted is small, because an excess of any kind of liquid may increase the dropsy by its accumulation in the subcutaneous tissues; excess of fluid increases blood-pressure, tends to apoplexy and various forms of hæmorrhage, and acts harmfully in heart dropsy.

A vegetarian diet has given rise to the same amount of discussion. Pel cautions us against those kinds which contain benzoic acid, as plums and green vegetables; but the majority of practitioners consider that the small amount which is contained in the few plums or green vegetables which are eaten may be disregarded. Asparagus, peas and beans, and some other vegetables, have been rejected because they contain nucleo-albumins or purin bodies. Porter[8] objects to the consumption of much carbohydrate because of the possibility of fermentative processes in the bowels; and says: 'Let the food consist of animal and vegetable, with a preference for animal, and the mixed diet will be an ideal one.' Vaughan[9] believes the disease is due to a toxicity of the blood-serum exerting a specific action on the excretory cells of the kidneys, which theory, he says, is

supported by clinical and experimental evidence. His main treatment is by means of diet, and his object is to profoundly alter the proteids circulating in the blood. He forbids all animal food in the form of meat, fish, game, poultry, milk, and eggs, and only allows cream and butter. The latter may be combined with cereals, such as maize, oatmeal, cracked wheat. Potatoes, peas, beans, green vegetables, and fruit form part of the diet; also sugar and Zwiebach—a kind of 'pulled bread'—that is to say, he resorts to vegetarianism. He gives the following[10] as a sample dietary to provide the necessary calories or units of heat and energy:

			Proteid.	Carbohydrate.	Fat.	
500 grammes (or 1 pint) of cream		=	5	27·60	150	grammes.
200 ,,	cornmeal ...	=	20	130·60	8	,,
100 ,,	Zwiebach ..	=	14	60·00	24	,,
50 ,,	butter ...	=	—	—	40	,,
20 ,,	sugar ...	=	—	20·00	—	,,
			39	238·20	222	

He takes no account of the fruit and green vegetables which are eaten. Reckoning the caloric value of 1 gramme of fat = 9, and carbohydrate and proteid each 4·1, these $(39 + 238{\cdot}20) \times 4{\cdot}1 = 1136{\cdot}5$, and $222 \times 9 = 1998$; total, 3134·5 calories or units of heat. This diet therefore allows plenty for heat and energy if it can be assimilated, and the proteid can be increased by substituting peas, beans, or oatmeal for a portion of the maize. After a few weeks, he says, his patients lose their desire for meat and eggs, and hard-working men live upon such a diet with ease, and the albumin in their urine decreases. It is to be feared that the amount of fat could not be assimilated; if it were it would increase the subcutaneous adipose tissue of the body, which most authorities consider an evil in connection with this disease. Vegetable proteid leaves a much larger undigested residue in the bowels than animal proteid, whereby the assimilation of this essential element approaches a perilously low degree. Oatmeal is very good, and contains iron and phosphates; green vegetables also contain iron in their chlorophyll. We may also allow cauliflower, cabbage, spinach, vegetable marrow or squash, green peas, kidney beans, potatoes, sweet potatoes, yams, watercress, celery, lettuce, onions, beetroot, bananas, plantains, and most kinds of fruit. Vegetables and fruit may always be eaten in moderation.

The organic acids and their salts arouse the appetite, increase the flow of saliva and gastric juice, and indirectly that of the pancreas and the bile; they are cooling, and stimulate the intestinal movements. The phosphoric acid contained in them increases the amount of phosphates in the red corpuscles of the blood, and they are therefore valuable for the anæmia. The vegetable acids and salts become oxidized during their passage through the body, and are converted into alkaline carbonates, which increase the flow of urine, stimulate the kidneys and skin, and thereby assist in the elimination of waste materials from the body.

Clinical experiments upon patients suffering from chronic Bright's disease by Zasiadko[11] of St. Petersburg, with vegetable, animal, and mixed diet, gave the following results: (*a*) With **vegetable diet** only, the albumin decreased markedly and the arterial tension sank; but the *dropsy considerably increased*, the pulse became slower and more compressible, the patient weaker and more apathetic. (*b*) On **animal** food alone, the *albumin increased*, the dropsy diminished, the urine and its solid constituents increased in quantity; the weight of the body decreased, but the pulse was stronger, fuller, and more frequent; the general state improved, the patient became stronger and more cheerful. (*c*) **Mixed diet** stood midway in its effects, but the amount of albumin was nearer to that produced by animal food. From these experiments he considers the rational treatment consists in raising the general nutrition by means of a liberal diet abounding in proteid, and that a mixed diet is the best. Italian chestnuts, roasted or otherwise cooked, are strongly recommended by him as an article of diet; they diminish the amount of albumin in the urine by virtue of their tannic acid.

Hale White[12] says restrictions on diet are unnecessary and harmful. We do not know for certain that any articles of food taken in moderation do harm to a contracted kidney. Plain digestible meals are the best; they should contain a correct proportion of proteid, carbohydrate, and fat, in such quantities that the patient feels well and keeps his weight; but sauces, condiments, etc., should only be allowed in very small quantities. He agrees with Von Noorden that neither clinical experience nor chemical analysis, nor investigations on metabolism, authorize us to give a preference to white meat in the treatment of chronic

Bright's disease. Too much meat should not be given; but when we allow any at all we have an unlimited choice as to the kind, and can easily satisfy our patient's desires. Saundby[13] permits butcher's meat (5 ounces) once a day; but where there are headaches or nerve troubles he stops all meat, game, or poultry, and only allows white fish, milk, butter, farinaceous food, fruit, and vegetables.

A dry diet is sometimes very useful for the dropsy. Finsen[14] found that with a consumption of only 400 grammes (about 14 ounces) of fluid in a day, the urine increased and distressing symptoms decreased; it causes a concentration of the blood, an absorption of fluid from the tissues by the lymphatics, and by removing pressure from the abdominal vessels in ascites the urine is increased. Oertel, Grocco, and Balfour bear out this statement.

In **uræmia** a milk diet is to be preferred, because it is free from purin, and yields very little toxic residue. The inhalation of oxygen is valuable to assist in removing by oxidation the retained toxic materials which are producing the distress; and leeches or cupping the loins may help to overcome the impermeability of the kidneys.

Sometimes an attempt is made to regulate the diet by the nitrogenous excretion in the urine, the amount of urea and total nitrogenous excretion being estimated at frequent intervals. If the nitrogenous waste is not excreted in proportion to the amount of proteid consumed, and the body is not gaining in weight, the supply of proteid must be reduced, as it is evident the kidneys are unable to excrete the waste matters, and must be irritated thereby. In all acute exacerbations of the disease the proteid must be temporarily reduced. When this principle is acted upon, previous to making out the diet list, the urine is collected for twenty-four hours, the amount of urea, total nitrogen, and percentage of albumin in it are estimated and, together with the weight of the patient, recorded. The patient is then placed upon an experimental diet for three days, after which the urea, total nitrogen, percentage of albumin, and weight of the body, are again recorded; and again after each space of three days until a dietary is arrived at which agrees with the patient, and the nitrogen excreted balances that in the food. The idea is to feed the

patient well, but not to induce fatness, which is a bad complication and a source of danger to the heart. The amount of proteid for a man doing work in ordinary circumstances should be from 90 to 112 grammes a day, and for a woman 80 to 100 grammes; these limits should not be exceeded in Bright's disease, but it is sometimes necessary to reduce the supply to two-thirds of that amount. If the albumin decreases, the density of the urine is satisfactory, and the general condition of the patient improves, such evidences show that the diet agrees. But if the general condition is not maintained, and the arterial tension and the density of the urine increase, even when the amount of albumin is not increased, it is probable that there is some error in the diet which must be rectified. There is no greater error in the dietary than to allow strong broth, soup, animal extracts, extracts of meat, meat powder, or substances like sweet-bread, spleen, liver, brain, oysters, mussels, the interior of crab or lobster, because the nitrogenous substances in them are in such a condition that they speedily enter the blood, and, whether transformed into urea or uric acid, they are quickly carried to the kidneys. The kidneys are thereby irritated, and when the materials are not excreted they intensify the risk of uræmia.

The amount of liquid which may be taken depends entirely upon the ability of the kidneys and skin to excrete it. If the skin acts well it may be made to assist in the excretion of waste materials from the body, and a good supply of liquid is then of value. But if the skin keeps dry and the kidneys are also unable to excrete water, we must be chary of allowing too much to drink, for the reasons mentioned in the paragraph on exclusive milk diet. Probably 3 pints daily may be allowed in the form of water, milk, tea, coffee, cocoa; but sometimes it is beneficient to give a dry diet, as already stated. Alcohol is forbidden by many authorities; indeed, it is badly borne, and may do much harm. A little of the purest whisky or Hollands gin, *well diluted*, may be allowed once or twice a day in certain cases, especially when there is cardiac weakness; but there must be no possible risk of excess. Beer causes a deposit of lithates, and with it an increase of albumin, for which reason it is forbidden. When alcoholism is the known cause of a case of Bright's disease, absolute abstinence is necessary for any improvement to be procured.

The medicinal waters are beneficial in many cases. The **alkaline waters** of Vals, Vichy, Ems, Apollinaris, Kissingen, Wiesbaden, Carlsbad, Bilin, Kronenquelle, Saratoga-Vichy, and Hot Springs, are useful for diluting the blood and urine, flushing the urinary passages, and promoting the removal of waste products. They should be taken as part of the daily allowance of liquid. The same remarks apply to plain water, to which has been added a little carbonate of soda or potash and common salt. In early Bright's disease puffy places under the eyes are frequently the only visible sign of trouble. If persons having such a sign make a practice of drinking freely of cold water or one of the mildest alkaline waters to the extent of 2 or 3 pints a day—*i.e.*, a tumblerful before and between each meal—the puffy places will vanish, their kidneys and skin will act better, to the improvement of their complexion and general health. The **purgative waters** of Carlsbad, Marienbad, Baden, and Friedrichshall, which contain large quantities of sulphate of magnesia and soda, are valuable aids to treatment by removing from the bowels the residue of the food, promoting the excretion of the waste of the tissues, and removing a quantity of water; by these means the arterial tension is lowered and the patient relieved of dropsy. The **iron waters** of Harrogate, Leamington, Tunbridge Wells, and Flitwick, also of Pyrmont, St. Moritz, and other Continental and Colonial places, are of undoubted value to enrich the blood in the anæmia and debility of Bright's disease, and may to some extent restrain the escape of albumin. The waters containing the sulphate and carbonate of **lime** have also an established reputation in Bright's disease, and especially those of Bath in England; Contrexéville, Homburg, Wildungen, in Europe; Bethesda and Buffalo in Virginia, U.S.A.

Baths of the various medicated and plain waters are useful. Warm baths at about 90° F. two or three times a week, and a Turkish or Russian bath once a month, encourage the action of the skin, relieve the kidneys of congestion, and invigorate the body generally. People past middle life should be cautious about taking *hot baths*, and should only do so under medical advice, for syncope may occur from weakness of the heart.

General Remarks.—The general health must be taken care of, the digestive organs watched, the bowels regulated, a record

of the percentage of albumin and the nitrogenous excretion kept. The patient must be instructed to avoid overwork, mental strain, worry, and excitement. The functions of the skin should be encouraged by warm baths, dry friction, and warm clothing. The patient should always wear woollen underclothing, thin in summer, thick in the winter; also thick boots with a warm lining. He must avoid chills, and assist the skin in its eliminatory function. It is best to keep the skin in a mild state of perspiration. Tight clothing should be avoided; it impedes the respiration and circulation, and is not so warm. Loose clothing is warmer than tight, because each layer encloses a stratum of air warmed by the body, which, however, is shut out by close or tight-fitting garments. **Woollen** garments are warmer than others, because their cellular nature keeps a layer of warm air near the body. Wool is also a bad conductor of heat and very absorbent of moisture; being a bad conductor, it prevents the loss of bodily heat, which is a matter of great importance to those whose vitality is low. **Cotton** garments rapidly conduct away the heat from the body, whence they are cooler; but cotton soaks up the perspiration, becomes wet, and is apt to cause a chill to the surface of the body. Linen rapidly conducts heat from the body, and is very cool; it does not absorb moisture so readily as cotton, but is considered inferior to that material for undergarments. A woollen garment readily absorbs moisture and retains it, but it also retains the heat. After exercise woollen clothes are warm and moist, which prevents that chilling of the body that is induced so readily by the evaporation of heat and moisture allowed by cotton and linen. Silk is a bad conductor of heat, and therefore warmer than cotton, but it is neither so warm as wool nor so absorbent of moisture; it is, however, cleanly, shrinks less, and is not so irritating to the skin as wool.

Exercise in the open air in moderation is beneficial by increasing the action of the skin and tone of the muscles. But violent exercise is bad by fatiguing the nerves and muscles, by throwing additional strain upon the heart and arteries, and increasing the amount of nitrogenous waste which the kidneys must remove. Patients should be forbidden to go out in bad weather or at night, even when they are improving.

Climate.—It is impossible for all sufferers to choose their place

of residence; nevertheless, a dry soil is necessary for their habitation; a rocky soil is the best if the surrounding air is good; and a clay soil or a low, damp situation should be avoided. Well-to-do people at any rate should change their abode, if they live in bleak, damp, windy, or seaside places. Those who are fortunate enough to be able to change their residence with the season should choose a place where the air is moist and warm and the temperature is agreeable, especially residing in the South during the winter. The following places are suitable: Bournemouth, Eastbourne, Devon, Cornwall, the Scilly Isles, Tenby and other places in South Wales, South-West Ireland; the Riviera, Italy, Algeria, Egypt, the Canaries, Madeira, the Azores, the Bermudas; South Carolina, Long Island, Florida, California.

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CHAPTER XXVI

THE PREVENTION AND TREATMENT OF TUBERCULOSIS

Tubercular diseases cause the death of one-seventh of the human race; it is therefore impossible to know or to write too much upon their prevention and treatment. Koch's discovery of the *Bacillus tuberculosis* and the means of recognising it has rendered an early diagnosis of the disease possible, and enhanced the value of all prophylactic measures.

All phthisical people about to marry should be warned of the risk that their offspring may develop the disease. Even if the individuals themselves be free from the disease, their children may develop it, if the stock be phthisical. Scrofulous, tuberculous, and superannuated people ought not to be married, or should not at any rate become progenitors; healthy, vigorous individuals should not marry cousins or their near relatives. All such alliances are likely to end in the production of children of

the scrofulous or tubercular diathesis, with a strong tendency to the development of consumption.

Children born of phthisical parents should be subjected to the same rules of life as a person who exhibits the early signs of the disease, so far as they can be enforced. This is the means of eradicating the inherited tendency to the disease, by fitting their tissues to resist the invasion of the *B. tuberculosis*, or, rather, unfitting them for the development therein of these bacilli.

Tuberculous mothers should not suckle their young, nor should their children be brought up by hand, if this can be avoided. The best means of fitting the infant for resisting the disease in its many forms, for warding off marasmus, tubercular meningitis, struma, scrofula, and diseases of the bones and joints, is to provide it with a good *wet-nurse.* The practice of providing motherless infants or the infant of a delicate woman with a wet-nurse has fallen into desuetude as other modes of feeding have become fashionable. This is unfortunate, for thousands of children now die or become the subjects of tuberculous diseases, owing to their being *bottle-fed*, who might escape these troubles if they had the milk of a good healthy woman. The practice is old-fashioned, and there are some arguments against it; but the greatest and most persuasive argument with most people is its expense. A wet-nurse should be subjected to a medical examination; she must not be of phthisical family, nor have any taint of this or any other constitutional or communicable disease.

If the child must be fed by hand, it should have the fresh milk of the cow, goat, ewe, or ass, modified to approximate mother's milk chemically. From six to twelve months of age the child may have, in addition to milk, a little beef-tea, clear soup, egg, or custard. Some of the milk may be thickened with one of the patent foods, baked flour, arrowroot, or bread. From one to two years of age porridge should be given for breakfast; the juice of meat, gravy, or clear soup for dinner, the rest of the food consisting of milk and milky foods. After the teething is over, the child may have a little finely-cut meat once or twice a day, and some bread-and-butter in addition to the other articles. Milk must still be given liberally for a long time, and the amount the child takes at meals should be mostly drunk first; after this

he may have as much bread-and-butter, potato and meat, or gravy, as he reasonably wants. The child's bread should not be soaked in milk or gravy; he should chew it so that it may be intimately mixed with the saliva, whereby its starchy ingredients are converted into sugar, and more easily digested. But milk may be given freely while the child is eating bread, between each mouthful or two, for more will be drunk so than otherwise.

In *childhood* the disease is promoted by every condition incompatible with health to which the system is exposed. The body must therefore be fortified against it by good food and hygienic management. In this period the diet should consist of plenty of meat, soup, eggs and milk, with a fair amount of bread, potato, and farinaceous puddings. Potatoes should not be taken to the exclusion of other things, but in moderation they are valuable for their starch, and the salts which give them their antiscorbutic properties. Oatmeal and lentils are valuable, as, in addition to their proteid and carbohydrate elements, they are rich in iron and phosphates. It often happens that, as soon as a child shows signs of tubercular glands or other such trouble, he is deprived of all bread and potato and dosed freely with cod-liver oil, as though the latter could entirely replace the former to the patient's great and lasting benefit. Bread and potatoes are not the cause of deterioration of the organism, nor should they be stopped from the dietary, except in so far as they are replaced by meat, milk, eggs, and other nitrogenous foods. It was formerly thought that a diet of bread and potatoes favours the development of the tubercle; and perhaps they do, but only because the diet contains an insufficiency of proteid material; therefore do not cut them off entirely, but add more nitrogenous food to the diet, as already indicated.

The importance of an abundance of fresh air and muscular exercise for children cannot be too much impressed on parents as preventive measures. It is useless to modify the diet and dose the child with cod-liver oil if, at the same time, it is allowed to sit all day long in a close room or crowded schoolroom. The schoolroom must be well ventilated, the school hours not too long, and long evening studies must not be allowed. There must be plenty of outdoor exercise in gymnastics, or at least with hoop, skipping-rope, or shuttlecock and battledore. The great

mischief is that girls give up their exercise too early in life; almost before puberty comes upon them they consider it unwomanly to exercise in this manner. As they become too old for childish games, they must be encouraged to continue to take exercise in the open air by a reasonable amount of hockey, tennis, cricket, cycling, or riding, along with their brothers, to whom exercise is equally a necessity. Indeed, to be successful in our object, we must definitely prescribe the amount of food and drink, the number of hours to be allotted to lessons, to play and exercise, and to sleep.

There is no remedy which has so well established a reputation as cod-liver oil, both in the prevention and treatment of phthisis, and there is no remedy which has been more abused. It must be remembered that it is not *every child* of tubercular habit or phthisical descent which is benefited by cod-liver oil. Physicians are taught this by daily experience. Frequently a child having a bunch of enlarged glands and a scrofulous appearance derives no benefit whatever from it, but is made worse, owing to the gastric digestion being upset, and to that distaste for fat which is so often the harbinger of phthisis. As a general rule, the child which is thick-set, plump, clumsy, lethargic, or of slow mental activity, is not benefited by it, even though there are enlarged glands and other signs of deterioration of the organism. The children most benefited by it are those who are dark-haired, thin, and slender, with a delicate skin which shows the veins meandering beneath it, and a general ethereal appearance; they usually have an accelerated pulse, are quick, sharp, of great mental activity and excitable nature; these are the children that require cod-liver oil, and derive great improvement from it. It must be administered to them for months to get really good results; the dose should be small at the beginning and gradually increased to three or four teaspoonfuls daily. The disgust which children have for the oil is soon overcome; they cease to fight against it, and even ask for their customary dose. It is advisable to leave it off now and then for a week or so, otherwise we may induce an unconquerable aversion to it. There are various emulsions, and mixtures of the oil with malt extract, which are more palatable than the plain oil; some of these are especially useful, but it must not be overlooked that the oil is diluted to the extent

of the articles mixed with it, and therefore a larger dose must be given.

Baths are very beneficial in these cases, and it so happens that the children who cannot take the cod-liver oil with advantage are the very ones who are the most benefited by bathing, and *vice versâ*. Ordinary plain baths have cured many cases of struma and considerably improved the tone of children with tubercular tendencies; but the medicated-water baths, such as sea water, brine baths, bromo-iodine, and sulphurous waters, are better, and are really valuable in these cases. The waters containing the elements referred to are justly esteemed as alteratives and promoters of metabolism; indeed, they enjoy a reputation as great as that of cod-liver oil, both for internal and external use. Where circumstances do not admit of removal to the source of the water, brine baths and sea baths can be used at home. The bath may be taken at almost any temperature between 60° or 64° (cold baths) and 100° F. (hot baths), but from personal experience I consider that nearly cold bathing does the most good.

Phthisical persons, and those of strong phthisical tendencies, should not marry. Phthisical persons should not occupy the same bed or bedroom with a healthy person. There are very strong grounds for belief that this disease is sometimes transmitted from husband to wife, and that those who continually nurse tuberculous patients sometimes become infected. Simple contact or occasionally visiting such patients is devoid of danger, as is shown by the daily experience of medical men, especially of the resident medical men and nurses in hospitals devoted to the treatment of the disease.

A predisposition to consumption was formerly believed to be shown by certain characteristics of the diathesis, of which there are two types: (*a*) The dark, beautiful person, of sharp mental activity, nervous, and usually thin—the tubercular type; and (*b*) the fair, coarse-skinned, muddy-looking individual, rather fat, clumsy, and of slow mental activity—the scrofulous type. Undoubtedly these types represent a delicate organization of the body, with tissues little able to resist the invasion of the *B. tuberculosis;* but a large number of phthisical people could not be classed with either of these groups.

Persons of known phthisical tendency or parentage should be

especially protected from the precursors of the disease, which have so often been observed in these cases, and may be called the *predisposing causes.* Among these we have to reckon—

(*a*) *Wet and Damp.*—Such individuals must avoid frequent exposure to wet and damp, which lowers the vitality and predisposes to many diseases. It is especially a combination of cold and damp that is the worst. There is an undue proportion of deaths from phthisis among people who live on damp or imperfectly drained or made-up soil. Where a choice of site is possible, delicate individuals must live in a good, healthy district, with healthy surroundings and all sanitary conveniences It is believed that a subsoil of sand or gravel is the driest, and therefore the healthiest, and this is true in the main. The situation must therefore be elevated and on a gentle slope to favour natural drainage, both in surface and in subsoil. Clay subsoil makes the house cold and damp by retaining dampness ; chalk, on the other hand, is usually dry but cold, because it does not absorb much heat ; and made ground must be avoided always.

There is a common belief that repeated colds are a cause of phthisis. The fact is that many persons with a predisposition to phthisis are frequently the subjects of catarrh. It is therefore highly important that such persons should avoid 'catching cold.' There is little doubt that a prolonged bronchial catarrh, a catarrhal pneumonia, whooping-cough, or even measles, will lower the resistance of the lungs, and so lead with other favourable conditions to the deposition of tubercles.

(*b*) *Deficiency of Animal Food.*—An absence of a due proportion of meat from the diet is one of the most prolific sources of ill-health, and in combination with overwork, worry, and such things, is a frequent predisposing cause of phthisis. On the other hand, high feeding is a grand means of fortifying the system against the invasion by it of the *B. tuberculosis.* In a person of phthisical stock, or with a known tendency to phthisis, the feeding should be carried out on the lines indicated for feeding in consumption.

(*c*) *The purity of the surrounding air* is a matter of nearly as great importance as the food. Overcrowding, working in close and ill-ventilated rooms or with the fumes of gas, etc., frequently co-operates with the foregoing as a cause of phthisis. The dust

arising from the material in the workroom may produce the bronchial catarrh or the catarrhal pneumonia which is the forerunner of phthisis. In many trade processes gases of an injurious character are evolved, and escape into the air which must be breathed by the workpeople engaged therein; but the vast majority of trades are injurious or otherwise in proportion to the amount and kind of dust produced. The long-continued inhalation of dust produces diseases of the respiratory organs, especially bronchitis and emphysema, interstitial pneumonia, and fibroid phthisis. The mortality from all causes among males engaged in dusty occupations in England and Wales may be taken as 1,000; of this, 200 deaths are due to tubercular consumption and 182 to other diseases of the lungs. This can be taken as a proof that pure air, well-ventilated rooms, and plenty of space, are as necessary as good food, and that the avoidance of impure air, bad ventilation, and overcrowding, are all-important in the prevention of disease. Besides this, the bacilli of the disease have been obtained from the floors and walls both of houses and workshops occupied by consumptive people; these must therefore be inhaled with the dust.

(*d*) *Exhausting discharges*, prolonged suckling of infants, and frequent child-bearing, are among the well-known precursors of consumption among women, and most certainly require attention.

(*e*) *Any condition which lowers vitality* predisposes to consumption, and renders a delicate person liable to its invasion; among these we must reckon excessive indulgence in alcohol, sexual excess, syphilis, and all other exhausting diseases.

(*f*) *The milk of cows* for domestic purposes should all be boiled. It is an animal food, and for that reason alone it ought to be cooked. It is also necessary for protection against chance infection by diseases; for there are several which can be transmitted to human beings by means of milk, and it is believed that among them we must reckon bovine tuberculosis. Stall-fed cows are very susceptible to tubercle. It is stated that 25 per cent. of cows kept in town are the subjects of this disease, and even the best-bred animals are liable to it. While in the glands the milk may not contain the germs; but there may be ulcers upon the udders, the discharge from which, laden with bacilli, becomes disseminated in the milk. It is argued that if cow's milk causes

tuberculosis in human beings the disease ought to commence in the bowels rather than in the lungs. Probably a large proportion of the cases of tubercle of the abdominal glands (tabes mesenterica) are due to this cause; but it does not follow that the abdomen must always be the primary seat of the disease when the infection arises from milk. The disease may begin in the abdomen, brain or lungs, or, avoiding these, the primary seat may be in a bone or joint. *It still remains to be proven that the milk of tuberculous cows does not cause tuberculosis in human beings, in spite of arguments to the contrary.* The bacilli in man and cows are identical in appearance, and it has been clearly proved that rabbits, dogs, guinea-pigs, etc., fed with tuberculous cow's milk will become tubercular. If the disease is thus transmitted to animals, why not to children? Indeed, there is strong evidence that it is so transmissible; and further support to this idea is given by the fact that the percentage of children under five years of age who die from tubercular meningitis, ulceration of the bowels, and tabes mesenterica, is very high.

(*g*) *The pet animals* of children—guinea-pigs, young dogs, kittens, white mice, rabbits, etc.—are prone to tuberculosis, and may possibly communicate it to the children who play with them. All weakly or sickly animals of this class ought to be destroyed without reserve.

(*h*) *The flesh of animals* is capable of transmitting certain diseases to man, including phthisis and tubercle. These diseases arise more commonly in other ways, but it must not be forgotten that such transmission is possible, and that such an origin would be far more common were it not for precautions taken to prevent the sale of unsound meat, and the additional safeguard in thoroughly cooking all kinds of animal food.

(*i*) *Not the least danger of infection arises from a person suffering with the disease*, and certain precautions are necessary to prevent his spreading the disease to others. The researches of science show that the patient's breath does not contain the bacilli, but that the phlegm or sputum may be loaded with them. If the patient spits upon the floor anywhere, and the sputum is allowed to become dry, particles of dust are formed, which float about in the air and carry the germs with them. The air of a room or other place may thus become sufficiently impregnated to be

positively dangerous to a healthy person, to say nothing of one who has a predisposition to the disease. The floors, walls, and furniture of rooms occupied by phthisical patients become infected by germs. The bacilli have been collected from such sources, and experimental inoculation of animals has produced the disease in them. Such experiments explain the frequent occcurrence of the disease in a particular house, among the employés of a particular warehouse, manufactory, barracks, or public institution. From these considerations we learn the following means of preventing the spreading of this disease :

Let proper care be taken of the sputa. A consumptive person must not swallow his phlegm, because it might be the means of spreading the disease to other organs in his body. He ought also to be careful not to be the means of distributing the disease to other people by it. Proper spit-boxes, spittoons, or cuspidors must be used ; they should contain a 5 per cent. solution of carbolic acid or other similar disinfectant. They should be capable of further disinfection by boiling or cleansing with a solution of bichloride of mercury. The patient must avoid spitting, except into such receptacles as are described, or into small pieces of rag or paper containing disinfectants.

The rooms used by a consumptive must be thoroughly ventilated. There is little doubt that frequent changing of the air dilutes the poison, diminishes the number of germs, and minimizes the risk of infection from this source.

The clothing, especially the underclothing and the bed-linen, of the patient should be boiled, or at any rate scalded, when being washed.

Thoroughly cleansing the rooms occupied by the patient is also of importance. An occasional 'spring-cleaning' is imperative, disinfectants being used in the process. When a person has died from this disease the rooms must be disinfected with sulphur or formalin ; the paper should be stripped off the walls and burned ; the ceilings and cornices limewashed, and all woodwork, including the floors, should be washed in a solution of carbolic acid or with carbolic soap.

Pre-phthisis.—In all cases of consumption there is a stage which may be called *pre-phthisis*, in which, before the deposition of tubercle in the organs, there are signs of deficiency and weakness,

with some deterioration of the blood, due to anæmia. In these patients a course of ferruginous preparations and waters is strongly advised. Such persons must exercise unusual care to avoid 'catching cold,' especially by wearing flannel next the skin. Sudden chilling of the skin is not followed by sickness in all cases; but undoubted examples have occurred to all physicians in which the signs of consumption made their appearance at no very long date after a severe chilling or unusual wetting of the skin. One must be quite sure that the catarrhal products in pneumonia are quite dried up, or pleurisy quite cured, before the patient is allowed to return to business, to school, or even to take exercise in the open air. The inflammatory products of pneumonia or pleurisy frequently become degenerated, and form an exceedingly suitable nidus for the growth of the tubercle bacillus.

Rest and Change of Air.—In the stage of pre-phthisis and in the early stage of consumption patients who have the means ought, above all things, to throw up their position in the counting-house, office, or warehouse, to avoid the overheated, dust-laden atmosphere, and also to avoid heated and tobacco-laden club-rooms. For, though the exposure of a person with a delicate chest to these bad influences may prove injurious to a weak lung and end in consumption, the disease is often promptly arrested and brought to a favourable issue by their careful avoidance. The patient must remove to a district with pure air, avoid work and worry, and lead a quiet life, the beneficial effect of change of air being equally marked in all classes of people. The object is to inhale a pure, bracing air for many hours daily without the risk of 'catching cold,' and without undue strain on the lungs. This may be obtained by a sea voyage of long duration, or by residence in certain districts of Colorado, California, Cape Colony, New Zealand, or at high altitudes in the Alps of Switzerland. The place of residence should be chosen according to the time of the year, one place being better for summer and another for winter. In less favourable climates there are many especially constructed sanatoria in which an outdoor life is adopted. In this open-air treatment the patients live as much as possible in verandas or summer-houses open to the air, but so constructed that they are protected from wind or wet. This treatment has

been especially marked with success in cases of non-feverish phthisis when used in combination with overfeeding.

Diet.—*Want of appetite, indigestion, nausea, and vomiting* are unpleasant symptoms of common occurrence in these early cases and during the whole course of phthisis. Catarrh of the stomach, with a distaste for fatty food and a very capricious appetite, are marks of the individual of strumous or tuberculous type, even before physical signs of the disease appear. Due attention must therefore be paid to it; the stomach must be coaxed or indulged to some extent; medicines given to aid its recovery promote appetite and encourage alimentary secretions.

Loss of flesh and strength is the rule. Emaciation is one of the earliest symptoms of the disease, and ought to be taken as a note of warning when a cough of unusual duration has been thought to be due to a simple catarrh or of pharyngeal or gastric origin. This sign must be met by overfeeding. The patient requires the richest diet that will agree with the stomach. All food is proper that contains fat or fat-generating and flesh-forming elements. **Milk** cannot be taken too abundantly: from 3 to 6 pints a day may be consumed. The milk of animals which feed on mountain pastures, as that of ewes or goats, is richer in flesh- and fat-forming substances than cow's milk, and is therefore commendable as a *milk-cure* when patients are within reach of it. But when patients cannot travel to obtain it, they must carry out the milk-cure at home with cow's milk. *Plenty of animal food* is required, as beef, mutton, lamb, *liver*, *spleen*, *sweet-bread* and *kidneys*, fat ham, bacon, game, poultry, and eggs. Most kinds of fish may be eaten, and oysters, either raw or cooked. **Soups** made of beef, mutton, chicken or game, may advantageously be thickened with rye-meal, lentils, pea-flour, bean-meal, barley-meal, or rice, and flavoured with tomato, celery, onion, etc. All kinds of meat essences are valuable.

Puddings consisting of milk and eggs, with farinaceous substances like oatmeal, hominy, rice, sago, tapioca, vermicelli, macaroni, are valuable; custards, jellies, trifle, cream, are also useful.

Vegetables: potato, cabbage, spinach, onions, asparagus, celery, watercress, lettuce, tomato, beet, and parsnip. **Fruit**: grapes (which contain 25 per cent. of sugar), strawberries, apples, dates,

prunes, figs, bananas, melons, cherries, mulberries, and all sweet fruits, are recommended. The drink should be chiefly of fresh milk alone, or with tea, coffee, and chocolate; buttermilk, whey; pure water; bitter ale or stout, Bordeaux, Burgundy, wines containing iron, and all sweet wines. Stimulants are not vitally necessary in early cases, and must by no means be allowed to upset digestion. There must be four good meals a day, about four hours apart; the patient should also have milk, milk and raw egg, or custard, at least once between the meals and in the night, if he awakes. We must insist that the food should be as rich as possible in nutriment, and yet as plain in the cooking as is compatible therewith, easy of digestion, and abundant. Fats and carbohydrates are as important as proteid food. Wholemeal bread is better than white, if it does not irritate the stomach. Oatmeal and maize are valuable as they contain much fat, lentils much phosphates and iron, bean or pea meal much albumin, and all green portions of plants contain iron and valuable salts. Milk contains all the elements required in the body, but is deficient in iron. Cream can be taken by many persons who are unable to take cod-liver oil; it can be given abundantly in tea or coffee, with fruit, or added to other milk, or made palatable by the addition of a teaspoonful of brandy or sal volatile. The fat in milk can be increased in fat by boiling finely shredded suet in it. Persons who object to fat meat may be able to take a large quantity of butter; it contains the same fatty acids as beef and mutton fat, but less of stearin and more of olein. It appears to be the stearoptene or stearin in meat which is objectionable to patients. Clotted cream and cream cheese are nearly the same as butter, consisting mainly of condensed cream. Cod-liver oil consists chiefly of olein, a liquid fat, together with some margarine, palmatin, and stearin, and about 5 per cent. of free acids which aid in the digestion of the fat. Cod-liver oil is commendable as a fat which is easily digested by patients; it is a valuable alterative by virtue of the traces of iodine and bromine which it contains, but we must not impress ourselves with the idea that it *cannot be done without*. It increases the richness of the chyle, and improves the quality of the blood. It only differs from almond or olive oil in its free acids and salts; but it contains less palmitin and stearin than

the fat of butter and meat. We must ascertain that our patients can digest cod-liver oil. It is contraindicated in gastric catarrh, diarrhœa, or hæmoptysis. In all other cases it must be taken for months together for its alterative effect, which is quite secondary to its action as a food.

Another important matter is the digestion of carbohydrate food. In many cases the secretions are defective in amylolytic ferments, in consequence of which the amylaceous foods, starches in particular, are but feebly acted upon. There is no more suitable remedy for this trouble than **extract of malt.** This consists of malt sugar, with some dextrin, albumin, and the soluble phosphates of the barley; it is both directly and indirectly nutritive. The sugar or maltose does not give rise to acidity and dyspepsia, like sweets containing cane-sugar; its albuminous constituents are flesh-forming, its phosphates and salts enrich the blood. Above all, it contains among its albuminoids an active ferment, **diastase,** which acts powerfully upon starch in bread and other foods, and converts it into sugar; good specimens of the extract will convert several times their bulk of starch into sugar. Diastase is most active in an alkaline medium; it is therefore better that the extract be given in some warm gruel or other farinaceous food just before a meal; or it may be given about two hours after the meal, when the acid of the stomach is becoming exhausted. It is often made the vehicle for administering cod-liver oil.

The **Anæmia.**—Oxygen is necessary for life, and the red corpuscle is the medium by which it is carried all over the body. The less oxygen in the blood, the more powerful are the demands for a greater activity in the lungs; hence quickened breathing and dyspnœa. Anæmia is the rule from the earlier stages of tuberculosis, and is due to loss of nutrition. The skin becomes pale and waxy-looking, the mucous membranes pale, the conjunctivæ of a pearly lustre; the breathing quick and more or less difficult on exertion; there is palpitation; also spots before the eyes, ringing in the ears, or faintness. Amenorrhœa is not uncommon. The treatment is largely by giving animal food, *red* meat, raw-meat juice, red marrow and its preparations, defibrinated blood, spleen pulp, liver, eggs raw and cooked; oatmeal and lentils, for their iron and phosphates; green vegetables, for

their iron-bearing chlorophyll and salts. It is useless to attempt to *force* the menses; but such drugs as iron, myrrh, and aloes, which act very largely by improving the blood and general nutrition, and keeping the bowels clear, may bring about the desired period.

A high temperature may or may not be present from early days; its presence or absence bears some relation to the activity or otherwise of the disease. When it occurs only occasionally, a few days' rest in bed until it has subsided is the best treatment. Such patients are not the best for *open-air treatment*, nor do they stand long journeys, even when taken for their health, very well. Pyrexial cases must not be exposed to all weathers, for they run the greatest risk of catarrh and consequent invasion of fresh tissue by the microbes during the attack.

The mental condition of these patients is usually one of great hopefulness and great confidence in their power of recuperation; even when very ill in bed they believe in their speedy recovery if only they could get rid of their cough.

Our chief reliance is upon the improvement of the body and its tissues in every possible way, so that it may be enabled to resist the inroads of the disease. This indication is best met by pure air, perfect hygienic surroundings, sufficient exercise, and abundance of good food.[1]

In **pronounced consumption** the most important symptoms are wasting, progressive debility, night sweats, fever, cough, expectoration, pain in the chest, shortness of breath, and the presence of the *B. tuberculosis* in the phlegm. Tuberculosis or tubercular consumption is a typical wasting disease. Some form of ill-health interferes with the nutrition, in consequence of which the cells of the body deteriorate and form a suitable growing place for the bacillus, which commonly settles in the lungs when it is inhaled, and in the abdominal glands or brain when the infection is taken into the body with the food. Deficient oxygenation of the blood follows, and causes grave secondary anæmia. The nervous system, no longer receiving its proper supply of oxygen and other nourishment, becomes readily exhausted. The toxins produced by the bacilli markedly impress both the muscular and nervous systems, whereby the previous deleterious effects of the process are increased. When large cavities are formed in the lungs the constitution becomes undermined by a septic process,

arising from suppuration of the walls of the cavities, in which toxins are produced by other micro-organisms such as the streptococcus and staphylococcus, which give rise to what is known as the 'mixed infection.'

The treatment of well-marked consumption should be chiefly by an out-of-door life, warm clothing, abundance of nourishing food, cleanliness of the skin, and friction with a rough towel every morning; daily moderate exercise by walking or hill-climbing, walking on a low-graded incline which necessitates deep breathing and flushes the skin with blood; and change of residence from a low damp to a high bracing or warm region, according to the character and stage of the disease. Such a regimen will increase the consumptive's power by building up his system.

Little need be added to what has already been said about the food. It should be sufficient to yield 3,000 calories. The importance of milk in all forms of wasting diseases cannot be insisted on too much; 2 to 4 pints should be taken daily in divided doses, with or in addition to the ordinary meals. It may be consumed in any form known to the art of cookery. Fat and carbohydrates are foods usually considered to favour an increase of flesh in most people, and they may be taken abundantly in all forms. Fat meat, butter, cream, cream cheese, suet in puddings, suet boiled in milk, cod-liver oil, salad oil, fish roe, and caviare, are very useful, and their digestion may be aided when necessary by a pancreatic emulsion. Carbohydrates, especially starch and sugar, in the form of bread a day or two old, which may be eaten with plenty of butter, and jam, marmalade, treacle, or honey, are some of the best forms. Milk puddings made of rice, sago, tapioca, revalenta or semolina, and enriched by the addition of eggs and butter, rank very high as flesh-formers; and their digestion may be aided when necessary by the judicious use of extract of malt. Wholemeal bread is better than white, because of the larger proportion of phosphates which it contains, but ordinary brown or *bran* bread may cause gastric catarrh. Lentil flour may be mixed with wheat-meal, and is valuable from its containing much iron and phosphates. Bean-flour added to wheat-meal also increases the nutritive properties of the bread, and gives the loaf a golden tint which adds to its attractive

appearance. Oatmeal and maize-meal are also rich in fat, fat predominating in maize and iron in oatmeal. No less important is the consumption of meat of digestible kinds, especially when we remember that 100 parts of proteid are capable of producing within the body 40 parts of fat. When, therefore, we recommend an abundance of meat with an abundance of other foods, we may sum up the dietetics of tubercular phthisis by saying *the patient must live well*, but chiefly on such foods as are known to encourage the formation of fat. The diet may, therefore, include all kinds of **soup**, especially oxtail soup, veal broth, kidney soup, turtle soup, clam soup, beef-tea, and other meat infusions, thickened with maize, lentil, bean or pea flour. **Fish** of every kind is permissible, and, being quickly digested, it allows a more rapid repetition of proteid meals than when the colation consists chiefly of meat In some instances it is advisable to keep to the lighter kinds, as sole, plaice, turbot, brill, flounder, haddock, cod; but the herring, mackerel, and salmon family, being *richer in fat*, should not be forgotten when the patient's digestive power is equal to the demand they call forth. All kinds of **meat** may be taken—mutton, lamb, beef, poultry, game, and eggs — raw, under-done, or well cooked, from a joint, minced, scraped, or in a powder. More meat can be eaten when it is well minced or scraped than when it is cut from a joint. Raw meat can be cut into small pieces and swallowed whole after dipping it in a little tomato sauce or chutney, and, being minced, it can be eaten in soup. Sweet-bread, liver, kidneys, oysters, snails, and raw meat, are said to be particularly serviceable to consumptive people. We cannot fix the exact amount of food which each person should eat, but it ought to be something above the normal diet—an abundant food, rich in proteid, fat, and carbohydrate. It should consist of materials readily digested, and care must be taken not to take foods which would cause indigestion or diarrhœa. As an example, the dietary of a case quoted by Dr. Mackenzie[2] is given. It included 3 pints of milk, 7 ounces of meat, 1 egg, 2 ounces of bacon, 4 ounces of butter, 7 ounces of bread, 3 ounces of potato, 3 ounces of cabbage, ½ ounce of rice, and 1 ounce of sugar. It contained 148 grammes of proteid, 212 grammes of fat, 222 grammes of carbohydrate, and yielded 3,560 calories. As the proportion of carbohydrate is small and the fat relatively

high, the diet might be improved by leaving out an ounce of butter and including more bread, potato, arrowroot, sugar, or other form of carbohydrate.

The Brompton Hospital dietary for consumptives contains 12 ounces of uncooked beef, mutton, lamb, or pork for men, and 8 ounces for women; as an alternative, 8 ounces of chicken, rabbit, or fish is allowed. The other items are — bread, 10 ounces; butter, $1\frac{1}{2}$ ounces; potato, $5\frac{1}{2}$ ounces; vegetables, 5 ounces; 1 egg; bacon, 3 ounces for a man or 2 ounces for a woman; tea, $\frac{1}{4}$ ounce; coffee, $\frac{1}{2}$ ounce; sugar, 2 ounces; cocoa, $1\frac{1}{2}$ ounces; milk, $1\frac{1}{2}$ pints.

The dietary of most of the German sanatoria is as follows: *Breakfast*, 10 to 20 ounces of milk, or the same amount of coffee or cocoa containing one or two raw eggs; also meat or bacon with bread-and-butter. *Lunch*, about 10 o'clock, a glass or two of milk with bread-and-butter, or a glass or two of port or sherry. The *dinner* at noon consists of a rather heavy meal of the ordinary articles. At 4 p.m. two glassfuls of cocoa containing a raw egg in each is taken with bread-and-butter. *Supper*, at 7 p.m., includes cold ham or meat from a hot joint with roast potatoes, bread-and-butter, and a glassful or two of beer or wine.

All consumptives must avoid badly ventilated rooms, crowded meetings, or a dusty atmosphere. A person whose occupation predisposes to consumption, as a printer, tailor, cloth-cutter, stone-mason, steel-grinder, or book-keeper, should change his occupation if possible to one which will enable him to spend most of his time in the open air. He must, at least, lead a steady and sober life, keep early hours, have regular meals, avoid over-exertion, and be out of doors as much as possible.

Change of climate is often a valuable aid in the treatment, but it is by no means a panacea for tuberculosis. A sea voyage is beneficial to many who are not feverish, but those who are feverish, or in whom the disease is rapidly progressive, usually do badly at sea. The best is a long trip to Australia or the Cape and back, avoiding the Mediterranean route, especially on the return journey.

The medical faculty has always been alive to the necessity for pure air laden with ozone, and a maximum of light and sunshine,

and certain localities have been found to excel in these essentials. The question then arises, Who to send and who not to send. It has been observed that in nearly every instance in which the tubercular process was actually arrested, and the tubercle calcified or cleared up, the diagnosis was made early and the patient speedily placed in a suitable environment, by which the destructive process was arrested. Many people have, as it were, been snatched from the jaws of imminent death. But life-saving and health-restoring as change of climate is to those who can afford it or are willing to ' rough it,' nothing can exceed the pitiful misery of many poor home-sick, perhaps moneyless, consumptives stranded in a foreign country, or, at any rate, a very long way from home, in the last stages of consumption, to die strangers in a strange land. It behoves us, therefore, to be careful in the selection of those whom we send, and the place to which we send them.

A high, dry, cold climate or ' altitude treatment ' is very suitable for early cases of phthisis, even of the hæmorrhagic type, if there is but little constitutional disturbance. The benefits of this change are chiefly of a mechanical or physical nature: improved ventilation and increased expansion of the lungs, necessitated by rarefaction and stillness of the atmosphere, the pressure of which is 20 or more per cent. lower than it is at sea-level; greater sunshine; pure dry air, free from dust or other floating particles; greater amount of ozone; a low mean annual temperature; and an exhilarating mental effect. These advantages may be obtained at Davos, Wiesen, and Maloja in Switzerland; the Tyrol or the higher Pyrenees; in the hills of South Africa; in the Catskill and Adirondack Mountains, or at San Angelo, Denver, El Paso, and Arizona in the United States; in Australia the Australian Alps and Pyrenees of Victoria, the Kosciusko group, the Blue Mountains and New England range of New South Wales, and Darling range in Western Australia. The altitude hostel or sanatorium should be not less than 1,000, and some of them are as much as 6,000, feet above the sea-level. Sir H. Weber considers that this elevation should only be reached by easy stages. Pregowski[3] and others state that the risks of hæmorrhage are less if the patient remains in bed for a few days after arrival. It is observed that the patient sometimes suffers from great weakness or a

relapse owing to the sudden change of climate, but a rest in bed and rather low diet for a few days after arrival will usually prevent such occurrences. It is also advisable, when the change of elevation and temperature is very great, that the room occupied by the patient should be warmed and the windows closed. This may appear to annihilate the benefit of a sudden change of climate, but Pregowski and others assert that the risk of hæmorrhage or illness in other forms is lessened thereby, and the benefit of change of air is just as sure, although it is derived more gradually. The people who do well are those with early phthisis, especially with an inherited or acquired tendency, most people with confirmed phthisis, and phlegmatic persons who are convalescent from pneumonia, pleurisy, or bronchitis. The people who do not do well at an elevation are thus classified from the writings of Sir H. Weber[1] and others : The nervous type of patient with quick pulse and little power of resistance or irritable disposition ; those who cannot eat or sleep well at an elevation ; persons with advanced or rapidly progressive phthisis in which there is continual fever, formation of cavities, rapid loss of weight, or complication by dilatation or valvular disease of the heart, ulceration of the larynx, and other diseases of the chest or kidneys.

A warm, dry climate is suitable for cases of a catarrhal type in which large cavities are found and there is an excessive secretion of phlegm—*e.g.*, Bournemouth, Nice, Pau, Egypt, Algeria, and Southern hill districts generally ; in America the high and dry regions of New Mexico and Arizona.

A warm, moist climate is best for those who have much cough, but not an excessive secretion of phlegm, as at Falmouth, Penzance, Mullion, the Scilly Isles, Hastings, Tenby, Aberystwyth, Margate, West of Scotland, South-West Ireland ; Cannes, Mentone, San Remo ; Madeira, the Canaries, the Azores, the Bermudas, and the West Indies ; in America, Long Island, Texas, Florida, Coloradó, and California. South Africa, New Zealand, and some of the American places, are adapted for men who can do out-of-door work and are willing to rough it. It is useless to send men or women who depend on luxurious surroundings and home comforts to such places, and the patient should be quite sure of a berth before going out, as many persons

have gone with little more money than would pay their passage. to find great difficulty in obtaining a position, and often no opening whatever for them.

The South of England has a superior climate, well adapted for invalids in winter—*i.e.*, December, January, February; but in March the temperature approximates that of the interior, and in April and May the temperature of the interior is slightly higher than that of the coast, and continues to rise above it in less ratio through the summer; in October the inland and coast temperatures are about equal, after which the advantage is again with the southern coast. Falmouth, Penzance, and all the coast of South Devon and Cornwall, and the Scilly Isles, have a softness and humidity of air which renders it valuable for all pulmonary diseases, except in persons of a very relaxed state of the body. Penzance is mild and equable, but damper than Falmouth. Bournemouth is a suitable resort for those of a relaxed constitution, and is delightfully bracing even in summer. Undercliff is sheltered and warm, and Ventnor has the highest temperature of any place in the kingdom. In the South of France, Pau is recommended for mildness, freedom from fog and cold sharp winds; Hyères is protected from northerly winds; Nice is subject to cold winds in the spring, but it is protected by the hills from northerly winds, and has a warm and rather exciting climate, suitable for early consumption. More advanced cases of consumption and other pulmonary diseases with very little expectoration would do better at Mentone. Madeira, the Canaries, the Bermudas, Algeria, and Egypt are suitable up to the end of April, and some patients may stay until the end of May. They should then return to one of our southern resorts for a month or two, and after June would do better inland or at one of the northerly health resorts.

Pine Forests.—Aseptic air is less powerful and has a less curative effect upon suppurative processes, such as occur in consumptive patients with marked cavitation and much expectoration, than air which is not only aseptic, but has that condition enhanced by the constant presence of an antiseptic material. All evergreen forests have a purifying effect upon the surrounding air by their exhalation of turpentine compounds. These form peroxide of hydrogen (a well-known antiseptic agent)

and balsamic vapours, which have a decidedly soothing and curative effect.

Sanatorium Treatment. — That climate and altitude are not certain to cure or produce immunity to tuberculosis is shown by the increasing number of deaths reported as *originating* in Colorado (a district where the disease was formerly unknown), and the fact that the death-rate from tubercular phthisis is little less in mountainous Norway than in the lowlands of Prussia or the Netherlands. The great number of patients who leave home for distant climates and die there, or return to do so, shows that change of climate is not infallible. On the other hand, the results of sanatorium treatment at home and abroad, in all kinds of country, shows that climatic treatment has been overrated. Many medical men now advise patients to go into sanatoria near home or to lead a sanatorium life at home. The chief points aimed at are—proper and abundant food, living constantly in the fresh air, regular habits of life, perfect hygiene, removal from a dust-laden atmosphere, and freedom from worry and business care. All these are essential points in the treatment of consumption, and are more important than mere change of climate. It is far better to lead a sanatorium life at home or in an adjacent country district than to continue to live in an impure atmosphere with other unhygienic conditions, combined with overwork, worry, and anxiety. Plenty of sunshine is very important; the drier the atmosphere the better. Generous diet is better than forced feeding, and rest is better than excessive exercise.

The Nottinghamshire Association for the Prevention of Consumption issued the following suggestions:

'1. *Fresh Air.*—Spend at least eight hours a day out of doors, Keep the bedroom and sitting-room windows wide open. Never sleep with them shut, however cold the weather. Draught is less dangerous than a stuffy room. Some draught is necessary to insure ventilation. Avoid crowded rooms, concerts, theatres, or public meetings.

'2. *Rest.*—Avoid violent exercise. At first sit or lie out of doors wrapped up and sheltered from the wind; later on take gentle walks, and increase the distance each week. If the temperature goes up, the exercise is too much; if it remains normal and the weight increases, gradually increase the exercise. Always rest

after meals. Running, jumping, heavy and dusty work, are forbidden.

'3. *The temperature* should be taken and recorded before breakfast, after dinner, and at bedtime. If it goes above 100° F. the patient should rest in bed nearly all day.

'4. *The weight* should be taken and recorded once a week

'5. *The Food.*—Take ordinary full meals. Eat slowly. Drink 2 or 3 pints of milk daily in addition. Avoid alcohol unless medically prescribed.'

Exercise in the open air must be enjoined in all cases, care being taken to stop short of fatigue. Walking is probably the form of exercise best suited to the majority of persons. It increases the respiratory, circulatory, and muscular activities. Riding and cycling may be indulged in to a moderate extent; singing and breathing exercises, and in some cases gymnastics, are valuable for the development and expansion of the chest. Moderation must be strongly urged. Everything in the way of strain must be avoided. The slightest evidence of difficulty in breathing or palpitation of the heart should be a signal to stop. Great efforts in running, cycling, riding, dancing, and singing must be equally debarred, or there will surely follow an attack of spitting blood, bronchial catarrh, and such physical exhaustion as will be a prelude to the deposition or extension of tubercle. The physiological result of exercise is the removal of resistance to the circulation through the small bloodvessels, whence there is an increased arterial circulation, to the relief of venous congestion and diminution of the work of the heart. The heart is the origin of the circulation, and, like every other muscle, owes its vigour to the activity of the circulation through it. Inordinate exercise cripples the heart, but judicious exercise strengthens it.

The following exercises for strengthening the heart and lungs are recommended by Knopf[5]:

1. In front of an open window or out of doors, assume the military position of 'attention,' heels together, body erect, hands at side. With the mouth closed, *take a deep inspiration*, and whilst doing so *raise the arms to a horizontal position.* Remain thus, holding the air in, for five or six seconds; then bring the arms down to the side during expiration.

2. The second exercise should not be begun until the first has

been practised for a few days. It simply consists in continuing to raise the arms till they meet overhead.

3. After practising the former exercises twice a day for several weeks, take the same military position, stretch the arms out horizontally until they meet in front, take a full inspiration while doing so; *then gradually move the arms backwards* until they meet behind the back, and remain so for a few seconds. This is a much more difficult exercise than the former, and is rendered more effective by rising on the toes during the act of inhaling and descending while exhaling.

4. Raise the shoulders and roll them backwards with a rotatory movement; hold the breath a few seconds, then, while exhaling, roll the shoulders down and forwards into the normal position.

5. Stand in the position of attention; place the *hands on the hips* with the thumbs forwards; then bend slowly backward as far as possible while inhaling; remain in that position for a few seconds while holding the breath; resume the normal position during exhalation. The habit of stooping and rolling forward of the shoulders will be prevented or cured by this exercise.

These or similar exercises can be taken by most patients, except when in the third stage of the disease. Perhaps Nos. 4 and 5 should be left out by persons who have a hæmorrhagic tendency. They should never be commenced when the patient is already fatigued, nor continued so long as to cause weariness. They should always be taken in an atmosphere as pure as possible. No restricting bands should be worn round the waist, and the mouth should be kept closed. If nasal breathing is not possible, an examination ought to be made for nasal polypi, adenoids, or other cause of obstruction, which should be removed.

REFERENCES: [1] 'The Prevention of Tuberculosis,' by W. Tibbles (*Detroit Medical Journal*, January, 1904, from which pp. 598 to 610 have been extracted and revised). [2] The *Practitioner*, April, 1906, p. 537. [3] *Zeit. für Tuberk. und Heilstat.*, February, 1904. [4] The Croonian Lectures on 'The Climatic Treatment of Phthisis,' by Sir Herman Weber. [5] *American Medicine*, July 11, 1903.

CHAPTER XXVII

THE HEART

Violent exercise normally causes a change in the blood-pressure, and there is a temporary enlargement of the heart's area from dilatation or relaxation of that organ, and sometimes a murmur. Acute dilatation of the heart is rare in young men who are well trained, but it occurs in many people who over-exert themselves when out of training. The chief result of training upon the heart is that it may produce an enlargement or hypertrophy. Habitual over-exertion will cause an irritable heart. Cardiac strain is liable to occur in youths who abuse tobacco or are addicted to other excesses. Tobacco-heart occurs in a good many people of a nervous or irritable disposition. Fatty overgrowth of the heart occurs in obese persons or results from excessive beer-drinking; and many diseases, such as dilatation, valvular disease, and enlargement, occur in persons who are predisposed to them by previous conditions of the body.

The life of people who suffer from affections of the heart should be free from strain, worry, and anxiety, either mental or physical. Mental emotion and sexual excitement are equally bad. All sports and athletics should be abandoned; running, climbing, rowing, cycling, and hurrying, should be avoided. An endeavour must be made to maintain or improve the bodily condition. The *diet* should be light, nourishing, and easy to digest—soup, eggs, milk puddings, light fish, boiled mutton, poultry, pheasant, and vegetables such as spinach, cauliflower, vegetable marrow, squash, green peas, kidney beans, a little mashed potato, and other vegetables which have been made into a purée. The patient should *avoid* eating much bread, sweetened dishes, and other carbohydrate foods, excess of fat, and all heavy kinds of vegetable. Other kinds of food capable of causing flatulence, indigestion, or constipation must be avoided. On the other hand, those conditions should be relieved when they exist. *Heavy meals* must be avoided, for which reason 'dining out' is practically tabooed, because anybody, without intending it, may readily consume much more than their ordinary quantity of food

under the stimulus of company, wine, and excitement. It is better in most cases to have frequent small meals rather than three large meals a day; but the last meal should be three hours before bedtime. Much tea or coffee should be eschewed, because an excess of them makes the heart irritable, causes palpitation, frequent pulse, and other signs of distress. On the other hand, a small quantity of any dietetic articles containing caffeine will strengthen and lengthen the contraction of the heart; and it is usually considered that China tea is the best of these beverages. Alcohol ought to be avoided as a rule by these patients; but for those with a dilated heart or in whom its sudden withdrawal might cause collapse, faintness, or other dangerous symptoms, we may allow some well-matured (eight or ten years old) Bordeaux, Moselle, or Rhine wine. In cases of loss of compensation and extreme feebleness of the heart, about $\frac{1}{2}$ ounce of genuine old brandy or whisky, diluted with 3 or 4 ounces of water, or about 1 ounce of good old port wine, may be allowed; but champagne and other aerated beverages are unsuitable because of the gas contained in them. The patient should not take a large quantity of soup, broth, or other meat extract. About a teacupful of soup at the beginning of dinner answers the purpose of stimulating the functions of the stomach. More than that amount would be an excess. It is not nutritious in proportion to the power of the meat extractives, especially of the purin class, to disturb the system.

Drinking an excess of any kind of fluid is injurious, because it distends the bloodvessels, increases the blood-pressure, and over-taxes the heart. On the other hand, an insufficiency of liquid causes a great reduction in the blood-pressure and retards the excretion of waste materials. Oertel,[1] Balfour,[2] Von Noorden,[3] and others, believe that the damaged heart suffers from an excess of fluids in the body, owing to the diminished action of the skin and kidneys. They aim at reducing the amount of liquid in the bodily tissues by limiting the consumption of liquids to 15 ounces a day. At the same time, they give an albuminous diet which consists largely of eggs, and the action of the skin, kidneys, and lungs in excreting water is increased by walking, mountain-climbing, hot packs, and Russian or Turkish baths. Schott,[4] Bezley Thorne, and other practitioners, on the other

hand, believe the strict limitation of the amount of liquids consumed to be not only useless, but harmful. They say the absence of water exercises an injurious influence on the kidneys, and causes an accumulation in the blood and tissues of the products of imperfect metabolism; that it induces arterial and capillary contraction, and increases resistance to the circulation in the small and narrow bloodvessels, whereby the heart is over taxed. They rightly limit the consumption of carbohydrate and advocate the free use of nitrogenous food, on the ground that the former supplies materials productive of fermentation in the stomach and bowels, with the generation of various acids and gases, and encourages the retention, if not the formation, of uric acid and other toxic materials.

All vegetables liable to cause flatulence must be avoided, as dried peas, beans, and lentils; cabbage, turnips, swedes, carrots, onions, leeks; also new bread, pastry, cakes, hot buttered toast, crumpets, muffins, and pancakes. We may allow dry toast, the crust of rolls, zwiebach or pulled bread, and biscuits. Potatoes are permitted if simply boiled, mashed, or made into a purée, but baked potatoes are disallowed. Entrées, stews, and hashed meat are bad; highly seasoned dishes, curry, and pickles, are not suitable: they irritate the gastric mucous membrane, cause thirst, and disturb the kidneys, thereby doing harm to a weakened heart. The worst spices are pepper, mustard, horseradish, and cayenne; but cinnamon, nutmeg, mace, and vanilla may also do harm by quickening the action of the heart. Indigestible fruit, such as currants, gooseberries, raspberries, blackberries, cranberries, pine-apple, and walnuts, Brazil and hazel nuts, are forbidden; but oranges, pears, apples, apricots, plums, peaches, grapes (if stoned), raw or cooked, and stewed prunes or figs, are desirable and beneficial. As already stated, strong tea, coffee, beer, or alcohol in any form, and tobacco, are as a rule deleterious. When gastric catarrh arises, which is very probable, the diet should be prescribed for that disease.

Senile Heart.—Dilatation as the result of weakness of the heart muscle occurs from many causes of debility, and is a marked feature of the **senile heart**.[5] Loss of tone and vigour of this organ is very frequently the result of gastric troubles, and is followed by dropsy of the lower limbs and sometimes of the

abdomen, because the heart has not sufficient power to circulate the fluids of the body in a proper manner. We have here an instance in which a more or less *dry diet*, as urged by Balfour, Oertel, and others, may be valuable. The diet should be spare; it may consist of dry toast, biscuits, or zwiebach; eggs, fish, meat, chicken, pheasant, sweet-bread or tripe; a tablespoonful of mashed potato or spinach; simple milk pudding, cooked fruit, such as apples or pears, or an equivalent amount of grapes, strawberries, bananas, or tomatoes. The liquid should only amount to $\frac{3}{4}$ pint a day, and may consist of a small cup of tea, coffee, or cocoa at breakfast and teatime, about half a wineglassful of wine at dinner, and 4 or 5 ounces of plain water without or with $\frac{1}{2}$ ounce of good brandy or whisky in the evening. The meals should be four and a half or five hours apart; the midday meal should be the principal one; no solid food should be taken with the afternoon cup of tea, and a light supper should be taken not later than 7 p.m. Those who are corpulent and flabby often find under this diet that their heart recovers tone, their weight diminishes, and their general health improves. But a reduction of the weight must only be cautiously adopted, and by no means be rapid.[6]

Graham Steele[7] and others have called attention to a condition in which the patients have symptoms of cardiac failure, such as shortness of breath on exertion, with some dropsy and venous congestion of the liver. An examination with the stethoscope reveals no evidence of heart disease, unless it be a strengthening of the second sound, or a lack of tone in the first or mitral sound, and an apex-beat which suggests enlargement of the heart. This departure from health does not originate in cardiac weakness, but from a derangement of metabolism. It causes an increase of arterial tension, and particularly an increased resistance in the small bloodvessels and capillaries, whereby an increased amount of work is thrown upon the heart. The heart becomes more or less enlarged in consequence, and would be overstrong for the work it would have to do in an average healthy individual; but it is relatively weak for the work caused by the increased tension in the vessels. This condition is frequently met with in women who are going through 'the change,' but it occurs in other persons in whom the processes of metabolism are unevenly balanced. A

proper regulation of the diet on the lines already indicated, especially reducing the consumption of starch and sugar, and living chiefly upon fresh meat and vegetables, will materially benefit the patient.

Arterial degenerations, arterio-sclerosis and atheroma, are common in middle life and old age. They occur in advanced life without obvious cause, but earlier than this, in late middle life, they arise from alcoholic excesses, gout, Bright's disease, and various chronic blood diseases. In the senile form the arteries are seen to be tortuous, dilated, and rigid, with apparently perfect health ; in all other cases there are symptoms of the causative or complicating disease. It is known that an excess of meat after middle life will cause various troubles, of which degeneration of the bloodvessels is an indication. Metabolism is not so active after the middle period of life as before, and as much food is not required. The extractives of meat, fish, or game are changed into urea with more difficulty, and are not so readily excreted. The presence of such substances in the blood excites the muscular coat of the vessels to contract, whence there is an increased resistance to circulation. If the irritation is long continued, as in anyone who continues to eat meals in which meat and game figure very prominently, degenerative changes are liable to be produced in the coats of the bloodvessels, ending in arterio-sclerosis or atheroma. Similar changes also occur from the long-continued presence of other toxic materials in the blood. Eminent men have stated that if the heart and bloodvessels keep sound there is every reason to believe that any person may live to an advanced age, and that old age is very largely the result of the degenerative changes in the bloodvessels (see ' Diet in Old Age ').

When such arterial degenerations are known to exist, great care should be exercised with regard to the diet. A mixed diet is the best ; but such foods only should be given which contain the least amount of purins and other toxins which are known to exist in flesh food.[8, 9] For this reason milk, eggs, milk puddings, and light fresh vegetables, with bread-and-butter, should form the staple food ; and *a little* well-cooked meat, fish, or poultry may be taken only with the midday meal. There should be a total prohibition of high game, pork, sausages, stewed or hashed meat, shellfish, lobster, crab, rich gravy or soup, and meat essences.

The quantity of liquid taken daily should not be large; on the other hand, an absolutely dry diet would be injurious. Milk taken without any other food for a few days together relieves the headache, insomnia, and restlessness from which these persons often suffer.

In all diseased conditions of the heart and bloodvessels the complicating affections must be treated, especially albuminuria, liver disease, gastric catarrh, and obesity.

In bad cases a change to a warm, dry, and equable climate is necessary for the winter. A place should be selected which has a fair amount of sunshine and level ground, so that out-of-door exercise can be taken by walking. When exercise is impossible, fresh air must be obtained by being taken out in a carriage or invalid's chair.

Baths.—As a general rule hot-water, Turkish or Russian baths must be avoided, although there are cases in which they have been beneficial. Warm baths and daily tepid sponging are very valuable by promoting the action of the skin and peripheral circulation. Alkaline baths at Bath or Buxton, sulphur baths at Harrogate or Aix, salt baths at Nauheim, and baths of the mineral waters at many other places, are good. The temperature of the water should be below blood heat, and the patient carefully watched lest syncope occur.

The Nauheim treatment consists of baths and exercises. Both can be carried out almost entirely in the patient's home, but they must be done under the supervision of a medical man, with the aid of an intelligent attendant. The method was introduced by the brothers Schott at Nauheim on the Taunus, near Frankfort-on-the-Maine, where a large number of people go annually for treatment from May to September. It was brought to English notice by Wetherhed,[10] Bezley Thorne,[11] Smyly,[12] Saundby,[13] and others. The cases suitable for treatment are those of dilatation, and lesions of the valves where compensation has broken down. The treatment is directed to improve the circulation through the small bloodvessels and spaces, by means of thermal, alkaline, or saline baths, and a system of gentle exercises.

The Baths.—The medicinal waters of Nauheim are derived from various springs, some of them being drunk and others used for bathing. The latter contain 2 or 3 per cent. of chlorides

of lime and soda, a little carbonate of iron, and some carbonic acid. The drinking-waters contain other alkaline salts in addition. A course of the baths is begun by using a water which contains about 1 per cent. of the chlorides at a temperature of 92° F. to 95° F., and the patient remains in it about six or eight minutes, and rests an hour after each bath. Stronger water is used on successive days, the temperature of the bath being gradually lowered, but its duration increased up to twenty or thirty minutes; the later baths consist of water charged with carbonic acid gas. The immediate effect of the baths is a reduction in the rate of the pulse, with a corresponding increase in the force and tension and a decrease in the area of cardiac dulness. This effect lasts for a variable time; at first it disappears rather soon and gives way to a return of the former condition, but the improvement lasts longer and longer as the course of baths goes on. Leichtenstern says salt baths containing carbonic acid are a tonic of the first rank for a weak heart. The heart which was formerly irregular in action, and wearing itself out by unusually frequent and fruitless contractions, is strengthened; the contraction is prolonged, the heart is more completely emptied, and the pause lengthened; along with these effects the removal of fatigue products is favoured, and the nutrition as well as the tone of the heart's muscle improved.

The baths can be artificially prepared, and Mr. Armstrong, of Buxton,[14] formulated the following proportion for each bath consisting of 40 gallons of water:

Bath No. 1: Sodic chloride 4 pounds, calcium chloride 6 ounces.
Bath No. 2: Sodic chloride 5 pounds, calcium chloride 8 ounces.
Bath No. 3: Sodic chloride 6 pounds, calcium chloride 10 ounces, sodium bicarbonate 6 ounces, hydrochloric acid 7 ounces.
Bath No. 4: Sodic chloride 7 pounds, calcium chloride 10 ounces, sodium bicarbonate 8 ounces, hydrochloric acid 12 ounces.
Bath No. 5: Sodic chloride 9 pounds, calcium chloride 11 ounces, sodium bicarbonate 16 ounces, hydrochloric acid 24 ounces,
Bath No. 6: Sodic chloride 11 pounds, calcium chloride 12 ounces, sodium bicarbonate 24 ounces, hydrochloric acid 40 ounces.

The first four are strong enough for most cases, passing from one strength of bath to a higher, after using the previous one for a few days.

The exercises consist of gently resisted movements; that is to say, the patient is directed to make certain movements, which

the nurse or attendant slightly resists. The exercises last from twenty to sixty minutes, short intervals of rest being allowed, and the resistance being gradually increased as the treatment proceeds. The following details must be observed: (1) Each exercise should be performed slowly and evenly. (2) No exercise is to be repeated twice successively. (3) Each movement should be followed by an interval of rest. (4) The attendant must watch the patient's face for the slightest indication of (*a*) dilatation of the nostrils, (*b*) drawing of the corners of the mouth, (*c*) duskiness or pallor of the lips or cheeks, (*d*) yawning, (*e*) sweating, (*f*) palpitation, (*g*) shortness or quickness of breathing. Should any of these signs appear, they must be regarded as signals to immediately stop the exercises and give the patient an interval of rest, the limbs meanwhile being supported. (5) Should the patient show any sign of difficulty in breathing or hold his breath, he should be directed to breathe regularly and uninterruptedly, which will be assisted by his counting slowly in a whisper during the exercise. (6) No portion of the body or limb to be moved should be constricted so as to impede the circulation or respiration. The exercises are as follows. The patient stands, and the movement is resisted by the attendant. At first the resistance is so gentle that it is scarcely perceptible, but it is gradually increased as the improvement in the patient's condition is observed:

1. Arms extended in front of the body on a level with the shoulder, the hands meeting; the arms are carried outwards in a horizontal plane as far as possible, and back to the original position.

2. Arms hang at sides with palms forwards; flex the arms one at a time until the fingers touch the tip of the shoulder; back to the original position.

3. Arms down, palms forward; carry the arms outward and upward until the hands meet overhead; back to the original position.

4. Hands rest one in the other at front of the abdomen; raise the arms until the hands rest on top of the head; back to the original position.

5 Arms down, palms against thighs; raise the arms in parallel lines as high as possible over the head; back to original position.

6. Standing erect, bend the body on the hips, and back to the original position.

7. Rotate the body to the left, then to the right; return to original position.

8. Bend the body laterally, both sides alternately.

9 and 10. Repeat the exercises 1 and 2 with the hands clenched.

11. Arms downs, palms forward; in turn, raise each arm forward and upward until it is against the ear; turn the limb outwards as far as possible; return both arms together to original position.

12. Arms down, palms against the thighs; move both arms backwards together, as far as possible in parallel planes, without bending the trunk.

13. With the hands resting on a chair, bend each thigh upon the body.

14. With hand on chair, let each lower extremity in turn be extended as far as possible backwards and forwards.

15. With both hands on chair, let each leg in turn be drawn up as far as possible.

16. With hands on chair and both feet placed together, let each leg in turn be put outwards as far as possible from the middle line.

17. With both arms extended horizontally outwards, let each arm be twisted at the shoulder-joint, backwards and forwards to the utmost limit.

18. Let each hand in turn be extended and flexed on the fore-arm to the utmost limit.

19. Let each foot in turn be extended and flexed to the extreme limit; return to original position.

Groebel prescribed similar exercises for heart cases, but added to them massage of the limbs, back, and particularly of the region of the heart. The effects of such exercises are very similar to those of the baths. The chief difficulty in practising them is to regulate the resistance offered by the attendant. They produce a reduction in the area of the heart's dulness, the apex-beat changes its position, and the rate and strength of the heart is improved. Dilatation disappears, compensation becomes established, albuminuria and dropsy have vanished. Sir Philip Smyly[15] says: 'The movements relieve the backward pressure

on the heart; there is a diminution in the size of the heart, owing to the absence of an excess of blood in its cavities; this is attained by there being more room in the arteries; the heart muscle gains strength by having more room to contract; the contraction being more complete, it takes a longer time, thus making the pulse slower and fuller. Being able to send on more blood, the heart receives more, and thereby removes venous congestion. The strength gained by the heart is due to the freedom to contract fully.'

Professor Schott maintains that the treatment acts on the heart through the nervous system by evoking a reflex influence which stimulates the regulating nerves. Sir W. Broadbent believed the primary and principal effect to be on the circulation through the small vessels and capillaries. Dr. Bezley Thorne says the baths and exercises alike favour the circulation by dilating the small arteries of the muscles and skin, and thus relieving the backward pressure on the heart; 'the results are such as would scarcely be believed except by an eye-witness. It is by no means uncommon in cases of dilatation to see within one hour the oblique diameter of the heart's area of dulness diminished by from $\frac{3}{4}$ to $1\frac{1}{4}$ inches, and to observe as much as 2 inches of diminution in the vertical measurement of the liver; to hear the patient volunteer the statement after the exercises that a load has been lifted from the precordia, that he breathes more easily and deeply, and experiences a sense of general relief. Such gains are not permanent, and in the time that intervenes before the next day's exercises or baths the dilated and congested organs tend to resume their former size, but do not wholly relapse. A slight proportion of the gain is held until, at the end of a few weeks' treatment, the dilated heart and congested liver have recovered their normal dimensions, or such contraction and compensatory power in the one case and resolution in the other as to make them practically sound.'[16]

The only conditions which contra-indicate the exercises are aneurism or extensive disease (atheroma or arterio-sclerosis) of the vessels. Improvement amounting to a practical cure is recorded in many cases of insufficiency of the valves, contraction of the orifices, dilatation of the chambers, with either of the foregoing or consequent upon disease of the heart muscle; fre-

quent hæmorrhage or anæmia; fatty heart, weakened heart; congenital defects, and angina pectoris of nervous or organic origin. The benefit is derived in all these cases from dilatation of the blood capillaries, lymph channels, and lymph spaces, by which means the peripheral circulation is improved and a larger area provided for the circulating fluids. The muscular contractions which take place during the exercises empty the veins, secure better filling of the arteries, and stimulate the contraction of the heart. The left side of the heart contracting with greater force and being better emptied, relieves the back pressure upon the pulmonary circulation, in consequence of which the right heart contracts better, the veins are thereby emptied, and visceral congestion and dropsy are removed.

It is the practice at Nauheim to supplement the cure by sending people to climb gradients at one of the higher health resorts in the Taunus, Black Forest, or Switzerland. This is known, however, not to be without danger; but it may be safe enough for hearts which have been strengthened by a graduated course of treatment at Nauheim, and it has strong advocates in Schott, Oertel, and Stokes. The latter, when writing of fatty heart, says: 'We must train the patient gradually to give up luxurious habits; he must pursue a course of graduated muscular exercises; and, if this is persevered in, he may be able to take with pleasure and advantage an amount of exercise which was at first totally impossible, owing to difficulty in breathing.' It is obviously more proper for young and middle-aged persons than for those in advanced life. The symptoms of cardiac debility are often removed by a course of gymnastics or pedestrian exercises in the Highlands of Scotland, Ireland, Switzerland, or other places.

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CHAPTER XXVIII

THE NERVES

There are millions of nerve cells in a human body having an independent life and work. Each is a sort of battery which generates nerve force when the cell is stimulated, and sends it along the connecting fibres in the nerves. Nerve force is a real thing, a manifestation of power which can be measured ; it is manufactured in the cells by the transformation of pre-existing energy. The force exists potentially in the food ; each nerve cell contains food granules, and it transforms the potential energy of the food into the kinetic manifestations of nerve force. Food and time to transform it into nerve force are therefore proper means of restoring weakened and debilitated nerve cells.

It has been shown by experiment that the nerves undergo changes during activity which can be recognised under the microscope. The changes consist of loss of substance and an alteration in the appearance and constitution of the nerve cells. When in proper working order, nerve cells are full, regular in shape, and of granular appearance ; but when exhausted they are shrunken and shrivelled. Under proper conditions, with rest and nutriment, the exhausted cells recover their regular outline and granular appearance ; whereby we are taught that the purpose of rest and sleep is to enable the nerve cells to become recharged with material and to be recruited for another day of activity.[1] Within certain limits the nerve cells become exhausted during the day, and recharged during the night or period of rest, which we call physiological. But when these limits are passed, and the ability to recoup and recharge themselves is absent, we have a pathological condition, nervous exhaustion, nervous debility, or **neurasthenia.** In this condition the cells lack the power to recover from exhaustion, to become recharged, or to transform potential into kinetic energy. It is manifested in many nervous diseases, but is likewise a disease *sui generis.*

Neurasthenia.—No two personal constitutions are exactly alike ; all vary in force, capacity, and ability to recuperate after

a strain. The persons most liable to neurasthenia are those with a highly organized nervous system, highly strung individuals who respond to very slight stimulation. The conditions of modern life, educational, commercial, social, and political, are such as to force people with ambition to their greatest efforts, thereby overloading the nervous system. There is a ceaseless struggle for supremacy in social, professional, and political life. This ceaseless activity, anxiety, and overwork, especially when combined with excesses or bad habits, exhausts the nervous and vital forces, and a nervous breakdown or neurasthenia is the consequence. This condition is a result of advancing civilization, for it is quite unknown among the native races of uncivilized countries.[2] It is necessary, therefore, that all people should have a judicious concern for rest in order to obtain recuperation, strength, and vigour of the nervous system. It is only by the adoption of proper means that they can retain a clear head, or a strong mind and nerves. The brain requires regular and complete replenishment to repair it, just as the batteries and wires of a telephonic system require attention. Oppression wears down the brain and nerves, and makes many neuropathic victims; many nervous systems are wrecked in the home, in warehouses, and other places of business, through commercial strain or the selfish disregard to the limits of nerve power. Both sexes are liable to neurasthenia. An hereditary tendency to nerve diseases predisposes to it. Many nervous systems which are free from hereditary taint will bear the stress and strain of modern life without exhaustion, or they quickly recuperate; but when there is a neurotic taint slight apparent causes may induce neurasthenia. It may also follow typhoid fever, influenza, and other infectious diseases in which the general nutrition is disturbed; it occurs as the result of gastro-enteric catarrh and other conditions in which there is a state of general subnutrition. Constitutional changes, like the climacteric in women, have the same effect. The absorption or development in the body of various toxins, and the habitual abuse of tea, coffee, alcohol, or tobacco, likewise interferes with the nutrition of the nerve cells. Shock, injury, and many other things will also cause neurasthenia in a person who is the subject of nervous instability.

The pathology is indefinite: either the nerve cells receive an insufficient amount of nutriment, or their power to assimilate and

transform it into nerve force is very defective. The nerve cells, which become shrivelled like the salivary cells after prolonged stimulation, have not the power to promptly recuperate. The disease is a mental and nervous condition resulting from this degree of fatigue; the nervous system is unstable. A similar instability of the nervous system occurs in other diseases, such as hysteria and hypochondria. In neurasthenia it is shown by great exhaustion following comparatively slight mental or physical work—a disproportion between the work done and the resulting exhaustion. In hysteria it shows itself by excessive emotion resulting from a slight cause—a great disproportion between the cause of the emotion and the effect. In hypochondria it is shown by abnormal introspection; the exciting cause, which is often really small, produces abnormal worry, fear, and mental depression.[3] Each is a separate ailment, but they frequently overlap in the same person, and continued observation may be necessary to make the diagnosis certain.

Prophylaxis.—The proper control of children from infancy would be effective in reducing the amount of nervous disorders in the world. When children are spoiled, or are not subjected to discipline and trained in obedience, a foundation is laid for many nervous troubles in later life. 'Spare the rod and spoil the child' is an adage as true to-day as it ever was. All parents may not agree with the necessity for corporeal punishment; but it is absolutely necessary that habits of obedience, punctuality, regularity, and promptness be inculcated; above all, control of the passions is essential to make a *mens sana in corpore sano.* The term 'spoiling the children' is correct. Loose discipline spoils the nerves, encourages the passions, and destroys the effect of other training. As an instance of good discipline, we have only to refer to the army and navy, where, from rude, unpolished, and practically useless units, there is produced a body of men which forms an admirable machine, the units of which are most adaptable to circumstances, most easily controlled, most obedient, and the most efficient in carrying out the orders of a superior.*

Grown-up persons must endeavour to reduce friction in their

* 'It is rather by the exercise of a wise firmness, free from irritation, of moderate discipline, mental as well as bodily, and by association with healthy minds, that the atonic or loosely coupled faculties must be strengthened' ('Prevention of Nervous Disease,' the *Lancet*, 1887, ii., 672).

commercial, domestic, social, and political life. They must avoid running at too high a pressure; must give time for recuperation after exhausting rounds of work or pleasure by frequent intervals of rest and repose, as week-end holidays. These week-end holidays should be genuine periods of rest, and not merely a change of place, which they threaten to become. They must avoid an excess of luxury, excitement, worry, passion, anxiety, late hours, unsuitable food, stimulants and anodynes.

Curative measures consist primarily in removing the cause and treating complications. Excesses must be corrected, over-work and over-pleasure must be checked, rest must be enjoined with freedom from worry and mental strain. The digestive, generative, and other organs must be treated if any real disease exists. This treatment will be materially aided by a course of diet, baths, massage, and electricity.

Diet.—Neurasthenia is a disease of subnutrition; the nerve cells are unable to assimilate nutriment or to convert latent into kinetic force. Most patients are thin—even when they eat well they do not gain weight or strength—but others are fat and flabby. The wisest course in most cases is to begin the treatment by putting the patient on a diet consisting chiefly of milk for a few days; 4 or 5 pints a day are necessary. Many patients fancy the milk disagrees with them; others consider the bulk is a great deal too much for them, but by giving it in small and divided doses they are usually able to take it, and it soon becomes acceptable to them when they are unable to get the numerous luxurious articles of food which they may have been accustomed to play with. Fat is an exceedingly important article of diet, and is readily obtained through the milk; but the quantity can be increased by putting additional *cream* into it. We must, however, gradually add other food to this diet—*e.g.*, a poached egg with a little bread-and-butter for breakfast, a little steamed fish or a chop in the middle of the day, and bit by bit build up a dietary similar to the following:

Breakfast should consist of two boiled eggs *or* two chops, *or* a piece of steak with bread-and-butter, oatmeal or maize porridge; 15 ounces of milk to drink; and fruit as desired Fruit must be taken only as dessert; care should be exercised that it is not consumed to the exclusion of other articles.

Lunch should consist of a tumblerful of milk.

Dinner, about 1.30, roast beef, mutton, poultry, or game, 6 to 8 ounces ; a little potato and bread ; boiled vegetables, such as cabbage, cauliflower, broccoli, spinach, marrow, *boiled onions*, asparagus, artichokes, sweet potatoes, green peas or beans. Milk pudding, or stewed fruit with *cream ;* $\frac{1}{2}$ pint of milk to drink.

Tea, a light meal of bread-and-butter, with honey, marmalade, watercress, celery, tomato, green onions, lettuce, or a similar vegetable ; two teacupfuls of China tea, with plenty of cream in it, or made with boiling milk instead of water.

Supper, 8 p.m., oatmeal *or* maize porridge, *or* boiled bread and milk, *or* milk pudding ; fish *or* tripe with boiled onions ; bread-and-butter freely ; $\frac{3}{4}$ pint of milk.

Bed-time, a final glass of milk while undressing.

No tea, coffee, cocoa, alcohol, or other stimulant is allowable (except China tea) ; but the patient must consume 3 or 4 pints of milk daily.

Weir Mitchell's treatment is very successful for females. It consists in removing the patient entirely from her friends ; she is isolated, and only visited by her doctor and nurse until very marked improvement is made ; the receipt of or sending letters to her friends should be prevented. She is kept in bed for a month or longer, during which period she is fed abundantly (which the patient may resist), and thoroughly massaged and galvanized daily to overcome the evils of rest and high feeding. During the *first week* in bed the diet consists chiefly of milk, advancing from a quart on the first day to 4 to 5 pints on the eighth ; it is given in divided doses, 2 to 10 ounces every two hours day and night. About the tenth day a mutton chop, a fried sole, or a boiled egg, with bread-and-butter, is added ; two days later $\frac{1}{2}$ pint of soup. On the fifteenth or sixteenth day she should be able to take *three full meals* consisting of soup, fish, meat, vegetables, stewed fruit, and cream, *besides* 2 *quarts of milk a day.* The treatment is to be continued for six to twelve weeks, according to the severity of the case. The patient is only allowed to get out of bed to empty the bowels and bladder. Massage is begun after the first few days, being performed for an hour, but gradually increased to three hours daily, and continued to the end of the treatment. Electricity is used for half an hour daily. To insure the con-

sumption of food, it is necessary that a nurse or attendant should always be at the bedside, or even feed her with it. It is remarkable what tricks the patient will sometimes play to induce a belief that she has consumed her food, and what means she will find to dispose of it when the nurse's back is turned. The nurse and medical attendant must therefore be very firm, although of a kind and sympathetic nature. There is always a considerable increase in the patient's size and weight, but some of it is lost after the treatment is abandoned. When this treatment is properly carried out the cure is usually complete and permanent. Weir Mitchell says:[4] 'I have watched again and again, with growing surprise, some listless, feeble, white-blooded creature learning by degrees to eat these large rations, and gathering under their use flesh, colour, and wholesomeness of mind and body.' Playfair[5] says there are limitations to the Weir Mitchell treatment; it is unsuitable for any form of organic disease of the nervous system; it should never be applied to any marked case of mental disease, as melancholy and other types of insanity, whether hysteria be a phenomenon or not; but there are many 'borderland' cases where it may be of great service. In all cases it must be done thoroughly or not at all.

When entire rest is not indicated, the patient should go to bed earlier at night and lie longer in the morning. Rest is strongly recommended for the majority of cases, but change of air and company are beneficial for others; and moderate work or pleasant exercise in the form of tennis, badminton, croquet, hockey, golf, cricket, riding, cycling, rowing, skating, tobogganing, in all cases stopped short of fatigue, assists in the ultimate cure. Summer resorts like Malvern, Harrogate, Ilkley, the moors and hills of Yorkshire, Cumberland, and Scotland; winter resorts, as the Alps, Tyrol, and other places, especially where ski-ing and tobogganing are to be had, are exceedingly useful; also Nice, Algeria, Egypt, and, in England, Clifton, Brighton, Bournemouth. The sea air does not agree with many nervous cases. A dry inland climate suits them much better.

In HYSTERIA[6 7] the patient may be bodily ill, but the disease principally affects the nervous system. It involves the higher functions of the brain, the will and judgment, and is accompanied

by an instability of the emotions. It chiefly affects females. A slight cause moves the patient to excessive grief, joy, tears, or laughter, which she has little power to control. There is an excessive desire for sympathy, which leads to the artificial production of symptoms and lesions. What are called 'hysterical fits' are always caused by emotional excitement; the movements differ from those of epilepsy, and the consciousness is not wholly lost. Some symptoms are the same as in neurasthenia. There are fatigue sensations, such as headache, and pain in the back or limbs. There may be disturbances of the motor or sensory nerves, such as flushes of heat or coldness, throbbing, burning, itching, tingling, trembling, numbness, and loss or increase of sensation in some part. Motor symptoms occur, such as loss of voice, difficulty in swallowing, partial or complete paralysis of a limb. The nutrition of the muscles may be good, although they sometimes waste, and the reflexes and electrical relations may be normal. There is loss of mental power, loss of spontaneity and power to concentrate the thoughts; mental irritability is increased, the patient is easily startled, easily worried, dreads to be alone, and may have a fear of death. Sexual weakness always has an exaggerated importance. There may be gastric catarrh, enteric catarrh, mucous colitis, and other diseases.

The treatment must consist of physical and moral methods. The diet should consist of milk, cream, eggs, meat, poultry, vegetables, good bread-and-butter, milk puddings, and fruit; plenty of liquids, to aid in their digestion and assimilation, and to flush the skin and kidneys. A good plain diet should be the rule; the meals regular, and not too far apart. Everything must be avoided which is likely to upset the digestive apparatus (see 'Indigestion,' 'Gastric Catarrh,' etc.). Salted meat is not so good as fresh meat or fish, because some of the nutritive juices go into the brine and are lost, and the fibres are harder of digestion. Tea, coffee, alcohol, and all other stimulants, are best avoided. Fish is believed to be aphrodisiac, wherefore it should be excluded from the diet of any who may have an erotic tendency.

Fresh air and out-of-door exercise are important. Tennis, croquet, hockey, golf, cycling, walking, skating, ski-ing, and tobogganing are suitable. Cycling sometimes causes an excite-

ment of the sexual organs, for which reason it may be tabooed. The vacancy and ennui of a dull and unoccupied life favours hysteria and habits of introspection ; therefore a regular occupation should be found. School life is good for girls, providing the hours are short and the tasks light. In all cases work and study should stop short of fatigue.

Baths and douches are very good ; the water should be about 80° or 85° F., neither hot nor cold ; the spine may be douched with plain water or sea-salt and water. Sea air and sea bathing are probably too exciting for the majority of cases ; but change of air to Clifton, Malvern, Tunbridge Wells, Ilkley, Harrogate, and many places on the Continent, may do very much good. General massage is not good for a large majority of the cases ; but local massage, when combined with baths, douches, and electricity, is good for muscular contractions, paralyses, and hysterical joints. Remove and put away bandages, crutches, invalid chairs, *et hoc genus omne.*

Moral treatment is very important. Forbid all reading of an imaginative or sensational kind, and especially of an erotic tendency, such as novels, certain poetical works, and sensational newspaper accounts of people's doings. Encourage the reading of history, biography, travels, geography, light scientific reading, and selected stories. Forbid theatres, music halls, and other exciting performances. Good music may be encouraged, especially that of a soft and soothing character, and may be made the means of occupying time for a few hours daily. Organ music is said to be injurious, because of the working of the pedals and the penetrating nature of the sounds ; and the same may also be urged against playing the violin, except by skilled hands. Patients who are subject to the erotic form of hysteria are often to be pitied. They are frequently women of refined education and environment of the wealthy and leisurely classes who have opportunity to give rein to their emotions and passions, and have not the steadying influence which comes from regular and compulsory occupation. They frequently fix their affections and desires upon prominent persons or those socially beneath them. It is absolutely necessary that these persons should be put upon a somewhat spare diet, with very little animal food and without fish or oysters. They should be found some occupation, either

philanthropic, literary, artistic, musical, or in carving, modelling, etc., which will occupy their time and allow them little room for thoughts about other matters. Young men may become erotic. Such an individual sometimes fancies himself to be the object of love by many women, but he is extremely bashful and distressed by the looks and glances of the opposite sex whom he meets in the streets, cars, or other public places. Sometimes he imagines they make signs or gestures to him; these he interprets into notes of love and admiration, which distress him and he has not the courage to reciprocate. The distorted minds of such people should be sheltered from all allurements of vice, from accounts of vice and immorality in newspapers, novels, poems, pictures, and all other forms. Inquiry should be made into the existence of possible sexual irregularities or causes of irritability in either sex, such as phimosis, stone in the bladder, ovarian or menstrual troubles, and constipation; the latter, by causing pressure upon the nerves and vessels of the genital organs, will increase such mental phases and seminal emissions or ovarian excitement. The bashful, timid man may be encouraged to marry; the robust, plethoric girl with unsatisfied desires may be found a husband; but care should be taken that the family history is good, for if ill-health is combined with hysteria marriage may cause lifelong misery.

Epilepsy spares neither sex nor race, but it occurs most frequently in persons who have an hereditary taint of epilepsy or other nervous disease. Excesses of all kinds increase the liability to it in people whose nervous system is unstable. A carefully regulated life, with freedom from excesses and excitement, is the best preventative in those who have a tendency to it. Alcoholism causes it very frequently. Alcoholic epilepsy is largely on the increase. This is a nervous disease with distinct symptoms due to the toxic effects of alcohol, which induces sudden attacks of an explosive or convulsive nature. The warning which these symptoms present should not be neglected by the alcoholic, for it is ominous of future trouble; but the prognosis and treatment is hopeful *if the drinking habit is abandoned.* There is another way in which auto-intoxication is connected with epilepsy; the epileptic attack is frequently preceded for a few days by a

diminution in the excretion of urea, which is markedly evident in uræmic convulsions.

An epileptic seizure is a violent discharge of nerve force, which results in convulsions and usually loss of consciousness. The nerve cells store up their energy during an interval, and appear to become overloaded. It is often observed before the fit that the patient was never better in his life. But the nerve cells are very unstable, and from some excitement or stimulus, or even without it, they discharge their energy with terrific violence. The pathology is not very clear, but a degeneration has been observed in the nucleus of the nerve cells, and there is an overgrowth of the indifferent tissues, such as the neuroglia and the coverings of the brain and nerves. Mental degeneration and moral degradation unfortunately often go on together. There is a loss of mental power and activity ; the patient is apt to become lying and deceitful, crafty and cunning ; at the same time there is loss of self-control, fits of anger or violence are common, and criminal tendencies or abnormal ambition may develop.

The treatment is mainly dietetic and hygienic. The food should be light, nutritious, and easily digested : bread-and-butter, milk, milk puddings, oatmeal or maize porridge, eggs, light kinds of fish, and a *little meat* (not more than 2 or 3 ounces a day for an adult), with plenty of cooked vegetables and fruit. Indigestion must be avoided, heavy suppers must be forbidden, and large meals are never good for the patient. The epileptic condition is decidedly aggravated by errors in diet, by bolting the food, and by an excess of meat. Some practitioners assert that epileptic children improve upon a vegetarian diet with milk, but do badly while they have any meat. Fresh vegetables and fruit are always valuable, and a *purin-free* diet may be the means of keeping the fits at bay for a long time. Strong tea, coffee, and alcohol are injurious. Excesses of every kind must be watched for and checked. Baths, douches, and massage are serviceable.

During the status epilepticus, epileptic coma, or prolonged unconsciousness which sometimes follows the fits, the patient must be fed with milk, egg and milk, or beef-tea, when necessary, by means of a tube passed through the nose into the gullet, or by nutrient enemata.

The life of such patients should be regular, well ordered, and free from excitement. Living in the country or an out-of-door

occupation is the best for them. Colony life is suitable for epileptics; much good is being done amongst them at Chalfont in Buckinghamshire, Craig Colony in New York, and other places. Habits of cleanliness and moral education are important. Epileptic children should have ordinary education suited to their position in life, but heavy tasks and work which is beyond their powers are tabooed. They should go slowly but regularly, and ought not to be encouraged to compete with others for prizes or scholarships.

Apoplexy and Sunstroke.—Apoplexy usually occurs in persons whose bloodvessels have become degenerated, and especially when they are atheromatous. Men are oftener attacked than women, but a short, thick neck and broad shoulders need *not* be taken as an indication of an apoplectic constitution, for there is no such thing. During the apoplectic fit or stroke no food can be given by the mouth until consciousness is recovered, and probably no harm will result from the patient being a day or two without food. The patient may, however, be fed *per rectum* with peptonized milk, egg and milk, or beef-tea; and the demand of the system for water may be satisfied by injecting into the bowels through a long tube a pint of plain warm water or saline solution two or three times a day. When the inflammatory stage of reaction has subsided, we may give a light and unstimulating diet, consisting chiefly of milk, eggs, bread-and-butter, the farinaceous materials, purée of vegetables, consommé, spinach, vegetable marrow, and occasionally a little light fish or chicken. When the patient is well excepting the paralysis, he may be sent to a hydropathic establishment for a course of waters, douches, massage, and electricity, or the same may be carried out at home as far as possible. It behoves the person who has had one attack of apoplexy to be extremely abstemious in diet for the future. He must not continue to eat, drink, and make merry as if he were in the prime of life, or another stroke will speedily be upon him. Let him *avoid* alcohol, strong tea or coffee, rich and sweet dishes, fat meat, pork, veal, beef, and mutton, and *live chiefly* upon milk, farinaceous materials, milk puddings, eggs, light fish and poultry, green vegetables and ripe fruit. If he also keep free from excitement, worry, and strain of every kind, he may possibly pass the rest of his days in safety.

Sunstroke or heat apoplexy is a trouble which occurs in very hot weather, and especially in hot climates, and, when recovered from, is a frequent forerunner of serious nerve trouble. It is a paralysis of all the functions of the brain, coming on slowly or suddenly. The heat of the sun's rays alone may not produce it, but when it is combined with fatigue or insufficient perspiration it will often do so. It should be guarded against by avoiding an excessive consumption of animal food, by due attention to the bowels, by wearing light woollen clothing, by using in hot climates a suitable helmet which will protect the back of the neck as well as the head, by caution against fatigue or direct exposure to the sun, and by living in well-ventilated rooms which are kept as cool as possible. If a person is affected by it the treatment is similar to that of a stroke: he should be placed in a shady place with a cool atmosphere; tight clothing should be removed—*e.g.*, collars and belts—the head and chest may be sponged with cold water or a cold spirit lotion, while mustard or ammonia is applied to the back of the neck and soles of the feet. As soon as signs of recovery begin to appear, a little stimulant may be given. Recovery is usually complete, but the individual thereafter may be unable to bear exposure to great heat, especially in a tropical climate, so that he may be unfitted for his post. Nobody who has had a bad sunstroke should remain long in the tropics.

Hypochondria and Melancholia.—In melancholia we have a patient who takes no interest outside himself; he is self-centred, his thoughts are concentrated upon himself and his doings, many of which exist only in his imagination. The chief indication is mental depression; a deep gloom is cast over the mind; he fancies he has committed abnormities of a most atrocious character, unpardonable sins, or that he has done something to ruin himself and his family, or a similar fancy. The general health is always impaired, and he is generally subject to insomnia. Melancholia chiefly affects persons from twenty to forty-five years of age, and is often induced by overwork, strain, worry, or grief, and tends to suicide. It is frequently met with in a milder form as hypochondria or mental depression. In this also the patient is subject to abnormal introspection from slight causes,

to self-examination or self-accusation with its consequent worry. It is more common in men than women. There is usually a morbid anxiety about the health, which frequently has its origin in gastric catarrh or similar ailment. The slightest symptoms are of the highest importance in his eyes, and he is apt to imagine that his doctor thinks lightly of his case. Consequently, he reads all the medical literature upon which he can lay his hands, whereby his trouble is exaggerated and his imaginary diseases increased manifold. He has gloomy thoughts, undervalues his physical or mental powers, believes his health or his business is ruined; suffers from headache, a sense of oppression on the top of the head, giddiness, loss of memory, nervousness, bashfulness, or shyness. He may believe himself impotent and unfit to marry; he has a morbid dread of infectious diseases, and frequently scrutinizes his own health, magnifies every symptom, and complains of many abnormal sensations, although a medical examination may reveal no physical signs of disease.

Treatment.—Recommend a generous diet — eggs, milk, fish, meat, poultry, game, digestible vegetables, and fruit; it should be similar to that for neurasthenia. In acute melancholia, if the patient refuses all food and is wasting rapidly, it may be necessary to resort to forced feeding. A tube is put down the œsophagus, and a meal consisting of 1½ pints of milk and two or three raw eggs, or as much soup or consommé, is poured down two or three times a day. In all cases there must be an avoidance of stimulants and foods which would be likely to upset or irritate the digestive organs. We must cure indigestion, gastric catarrh, constipation, anæmia, gout, and other complications which may exist; but the patient should not be treated much by drugs if the organs are sound.

Out-of-door exercise, and an occupation which will allow but little time for thinking about ailments and troubles, are essential. Indeed, the treatment should be mainly hygienic and moral. Variety may be sought in change of occupation or climate, always with a suitable companion, and an endeavour must be made to distract attention from himself. Nothing is better suited for this than travel, variety of scenery, and occupation; ennui is one of the worst enemies. Many of these people have real or

imaginary troubles. To such the Italian proverb applies: 'If all cannot live on the piazza, all may feel the sun.' Life is full of sunshine for those who wish to absorb it, but full of gloom for those who take a morbid delight in dwelling in the shadows. The troubles and difficulties of life, when bravely met, will strengthen the mental calibre and moral character of men and women. If anticipated and worried about, they debilitate the brain and nerves and enervate the whole system. 'Life is full of difficulties for all; if we wait until we conquer all our difficulties, ease and merriment will never come. Laugh and be glad now! The troubles which look like towering rocks ahead will vanish like soap bubbles or mist as we approach them. If we let an avalanche of trouble bury us, we have none but ourselves to blame. Drink the wine of life, not the lees. If you must indulge in fancies, weave them in bright colours rather than in the sombre hues of night. I find the gayest castles in the air that were ever piled far better for comfort and use than the dungeons in the air that are daily dug and caverned out by grumbling and discontented people.' If such people would look about them, they might find their own troubles to be small in comparison with those of some of their neighbours. If they would endeavour to lighten the troubles of people who are in a worse plight than themselves, they would probably find their own troubles would grow much less, and very often entirely vanish.

> 'Go toil in any vineyard,
> Do not fear to do or dare;
> If you want a field of labour,
> You can find it anywhere.'

There are various PREMONITORY SYMPTOMS which occur before any pronounced form of nervous disease exists which should by no means be neglected. Such are the attacks of headache, giddiness, frequent loss of memory, insomnia, restlessness, 'fidgets,' and irritability, which occur in a person unaccustomed to them. These warnings are of nervous origin, and indicate that the nervous system is readily exhausted. Steps should be taken for recuperation; perhaps rest from business is required, or change of company and climate. Constant work without needful rest and recreation will wear down the best nervous system, especially when combined with worry and anxiety. If the person who has

been a slave to his business or to study begins to show these signs, he must take a longer rest, give an hour or two a day less to work, go to bed early, sleep well, endeavour to remove friction, and cultivate pleasant, cheerful society. If he does so his bodily machine will run more smoothly and wear longer; but if he persists in long hours of work, works in a closely confined area or in a crowded neighbourhood, never relaxes the bands which bind him to his office or duty, never gets into the country air or cheerful company, he will find nervous attacks, headache, insomnia, bad temper, or irritability will dog him and render him less fit to do his business, and probably be the forerunners of a nervous breakdown of a serious character.

Insomnia or sleeplessness is one of the premonitory and persistent signs of nerve trouble in many people, and in other diseases it is sometimes the first sign of the health breaking down. It may be due to exhaustion, congestion of the brain, malaria, alcohol, coffee, tea, or tobacco. Mental work carried on until bedtime often prevents sleep. The drugs used for it are legion, but it is inadvisable to take them regularly, as 'a habit' may be formed. They should be reserved for special cases or special times, and should not be resorted to until other means have been fairly tried. Much good may be done by hygienic means. Let the person live plainly, but well; take plenty of open-air exercise; avoid worry and excess of mental work. The circulation of blood through the brain has very much to do with sleep. Whatever disturbs it may cause insomnia—*e.g.*, worry and anxiety, by keeping the brain active and its arteries full. Coldness of the surface of the body, especially of the feet and lower extremities, will drive the blood inwards; the brain then receives an undue share of it, and the person is kept awake. Disturbance of the circulation may be best remedied by taking walking exercise before going to bed, or by rubbing the extremities with a flannel or towel; sometimes by a warm supper, a glass of hot milk, whisky, or other 'night-cap,' which will warm the body, flush the skin, and stimulate the peripheral circulation, and thereby reduce the flow of blood through the cerebral vessels. When the head is hot the application of a cold-water bandage to it is soothing, and may produce sleep. Certain articles of food,

such as onions and lettuce, are soothing, and induce sleep. Stout, beer, and other alcoholic beverages containing hops will produce sleep in persons who are not much accustomed to them. On the other hand, tea and coffee stimulate the cerebral circulation and excite the nerve centres, with consequent wakefulness or restlessness. All substances containing caffeine are prejudical to these people, and most certainly ought never to be taken in excess, and not at all later than about 5 p.m. An excess of tobacco causes or keeps going many cases of insomnia. Sleepless persons ought not to smoke for an hour or two before going to bed; they should walk in the air for twenty or thirty minutes after the last smoke; and if this fails, they should abstain from tobacco altogether for a few weeks. The influence of tobacco on the vasomotor nerves is such that the cerebral vessels are unable to adjust themselves to the condition required to produce healthy sleep while under its influence. Sometimes a mustard foot-bath at 110° or 115° F. just before retiring will induce sleep; and a warm bath to the entire body acts by promoting the peripheral circulation and lowering the general blood-pressure. In a good many cases it is sufficient if the patient has a warm supper, goes to a comfortable bed at a reasonable hour in a quiet and darkened room, is warmly wrapped up, lies upon the right side, and breathes slowly and regularly. Something should be done to prevent the thoughts from wandering from one thing to another, or to abstract the attention from a worrying subject. Various methods are adopted, such as counting up to several hundreds, attempting to master an abstruse problem, or learning a piece of Latin or Greek. In chronic cases of insomnia a trip to the Cape and back, or a change of air in a high or mountainous district, when combined with plenty of out-of-door exercise, is very valuable; but a change of occupation or a complete mental rest is sometimes necessary to cure it.

Headache is a common forerunner and symptom of nervous disease; it may be due to overwork or nervous exhaustion. Vasomotor disturbances occur, and the nerves are unable to control the rush of blood through the vessels. The arteries, being distended, press upon the nerves which run by their side, or on the tender brain substance, and cause pain and stupor. The best

remedy is to do no more work or study than the strength will allow ; to avoid worry or anxiety, and not to dwell upon failure, but to hope for success. The diet should consist of easily digested food, especially milk, eggs, oysters, oatmeal, vegetables, and fruit. Excesses in eating or drinking must be avoided. Exercise in the open air and baths should be taken daily ; an out-of-door life is the best. Attend to the bowels, sleep well, and rise early. **Migraine**, or sick headache, is due to a nerve storm according to Fagge, or a paroxysmal neurosis according to Liveing, while others support the vasomotor theory of its origin. The popular term ‘ bilious or sick headache ’ arises from the fact that vomiting sometimes occurs, especially when an injudicious meal has been eaten. Patients who are subject to migraine should have a plentiful but light diet ; avoid indigestion, hunger, chill, exhaustion, mental overwork, worry, and anxiety ; and must live a quiet and genial life as much as possible in the open air. When the attack occurs the patient should lie in a darkened room, have cold compresses of vinegar, aromatic vinegar, eau de Cologne, or camphor water applied to the head, hot-water bottles to the feet, and remain very quiet. As a rule the patient can take no food for a few hours ; but a little ice to suck, soda-water to drink, or infusion of guarana, with a slice of lemon or a tablespoonful of lemon juice in it, may help to relieve the pain. The first meal should consist of a little clear soup, and the next one of tea and bread-and-butter or fish. Electricity is useful in curing some of these cases when they are due to nervous trouble ; but the proper treatment of all headaches is to remove the cause.

Every headache is not due to nervous disease. Sometimes it is due to eye-strain, astigmatism, deficiency of pigment, and excessive use of the eyes in a bad light. If the headache does not yield to medical and hygienic measures, an oculist should be consulted. Gastric troubles or constipation are often the cause of headaches, and should be corrected. Persons of a gouty or rheumatic tendency and of the uric acid diathesis frequently have very severe headache after exposure to cold, draught, or sudden changes of temperature. This variety is usually relieved by warmth, dry flannels, a hot-water bag, or gentle friction to the head. The pain may, however, last for several days, owing to a deposit of urates upon the sheath of the fine nerve filaments.

Proper gouty or rheumatic remedies are necessary; but the constant electric current, electric brush, massage (stroking and kneading), and hot-water or vapour baths, are of considerable value. Early Bright's disease is another cause of severe headache. The urine ought to be examined for albumin and casts in every case where the headache is frequent or persistent. Auto-intoxication arising from the absorption of albumoses or other toxic substances from the alimentary canal is another cause of violent headache. This form is best treated by light feeding, a brisk purgative, and a mustard foot-bath. It may likewise be due to congestion of the liver and lithæmia, which should be treated by proper diet, bathing, and plenty of exercise.

In *children* a chronic headache is sometimes due to very rapid growth, especially between nine and twelve years of age. The pain is most severe in the morning, and is in the forehead. It may be associated with 'growing pains' or vague pains in various joints; but is accentuated by school-work and relieved by rest. Such children require tonics, nourishing food, and shortened hours of or complete rest from study. In other children fatigue of a physical or mental character is often a cause of headache; clever children are as liable to it as slow ones. Anæmia, constipation, worms, gastro-intestinal disorders, auto-intoxication of intestinal origin, and other causes of headache, may frequently be removed by careful attention to the diet, regularity of meals, watchful care over the hours of study or play, ventilation of schoolrooms or dormitories, and other hygienic measures. Adenoids, disease of the ears, decayed teeth, and errors in refraction or other eye troubles, must be attended to.

General Irritability is a sign of nervous weakness or exhaustion. The persons who are subject to it are often very thin and decidedly nervous. They ought to endeavour to put on flesh, to become fatter; by so doing they will feed and strengthen their nerve cells, which normally contain a large amount of fat. Thin people frequently do not drink enough of anything, in consequence of which their tissues become dry, and there is not enough liquid in the system to carry away the waste materials of the body. They should drink 2 or 3 pints of milk daily in addition to their ordinary food; this would supply the necessary liquid

and a good deal of fat and proteid. Water would replace it as a beverage, but does not possess the same nutritive qualities. Ale and stout are useful in moderate amount when taken with the food ; but 2 or 3 pints daily could not be seriously recommended to such people, nor would it contain the necessary fat and proteid.

Their food may consist of the ordinary meals, and include eggs, fish, oysters, lobster, crab, liver, lean and fat meat, milk, cream, cream-cheese, milk puddings, sweets, thick soup, oatmeal, maize ; also plenty of bread and an abundance of butter ; potatoes in any form, sweet potatoes, yams, cauliflower, boiled onions, carrots, parsnips, beet-root, peas, beans, and lentils. **Lecithin** is one of the forms of organized phosphorus in the body, and is of decided value for all forms of nerve trouble. It is contained in peas, beans, and lentils in a greater proportion than in any other vegetable ; and in eggs and milk more than in any other animal food. Oatmeal is rich in phosphates and maize in fat. Salted meat or fish is not good for these people, and they must avoid all kinds of indigestible food. People who are troubled with nervous startings, fidgets, trembling, sudden waking from sleep, or a sensation of falling, are often cured by a milk diet. Complications should be sought for—*e.g.*, diabetes, Bright's disease, and other causes of wasting.

The patient must endeavour to cultivate a placid, easy frame of mind ; perseverance and determination are very helpful in that respect. He must avoid being troubled by trifles ; worry interferes with digestion, and the fullest benefit is not obtained from the food. He should avoid hurry and bustle, but make his life as easy as possible. A rest and, if possible, a short sleep after the mid-day meal is very beneficial. He should sleep ten hours at night. Warm clothing is essential at all times, and especially in bed Exercise is conducive to healthy appetite and digestion, encourages sleep and a feeling of comfort. Some thin persons think exercise is not good for them, which is an error ; moderate exercise in the open air encourages appetite and digestion, and will thereby assist in increasing their weight. Much benefit may be derived from a sojourn at Bournemouth, Nice, or Cannes. A very cold, dry air, and sometimes the sea air of our eastern and northern coasts, increases neuralgia and general irritability ; for

such people Torquay, Penzance, the Scilly Isles, Mentone, Algiers, Egypt, and similar climates, would be more suitable. A long sea trip is very good for many people, as much as 2 stones in weight having been gained during a voyage to Australia and back.

The Menopause, or change of life in females, is attended by marked disturbance of the nervous system, the nature of which is not distinctly understood, but it is undoubtedly connected with the functions of the ovaries. It is said that the internal secretion of the ovaries is a peculiar substance of value in the economy by facilitating the oxidation of the carbohydrate and the organized phosphorus of the food, and that the absence of this material during the menopause disturbs the physiological balance and causes various peculiar conditions.[9] Whatever the function of the ovaries may be in this respect, it is clear that in females there is a wave of metabolic activity which reaches its climax just before each menstrual period; during the rise of this wave there is a formation of new blood cells, an increasing amount of nerve force and vigour, and a feeling of *bien-être*. A woman gains 1·5 to 5 per cent. of her total weight in the intermenstrual period, which is partly due to diminished excretion of carbonic acid and water; but during *the period* there is a corresponding loss, owing to increased excretion of carbonic acid and water, although the proteid metabolism is diminished.[10]

The **climacteric**, or 'change,' is due to a complete alteration in the condition of the reproductive organs. The calibre of the vessels is lessened and the blood-supply diminished; atrophy of the ovaries, Fallopian tubes, and uterus occurs; the mammary glands become flat and shrivelled, and other parts lose the characteristic form and appearance of the reproducing period.[11] Such a disturbance of the ovarian functions and such extensive changes in the structure of the reproductive organs has the effect of a physiological revolution, during which women suffer bodily and mentally. A multitude of symptoms occur even in a normal menopause, such as headache, feeling of pressure at the top of the head, tremblings, flushes of heat and perspiration, palpitation and shortness of breath, sleeplessness, nervousness, fidgets, irritability, nervous depression, and many other symptoms. During its course all physiological functions are weakened, all pathological condi-

tions aggravated.[12] Many external factors have a decided influence upon it, such as the social position, mode of living, climate, and race. It behoves all women to see to their health, so that they may enter upon this period in a state of fitness; all must experience it, none can escape it. Such diseases as erosions, endometritis, laceration of the cervix or perineum, leucorrhœa, hæmorrhoids, constipation, anæmia, neuralgia, and similar ailments, ought to be cured. During the 'change' the excretions and secretions should be looked after. The urine should be examined frequently for albumin or sugar, which may throw light upon various symptoms. The nutrition should be watched, waste and repair should balance. The patient should lead a regular and careful life; take plenty of outdoor exercise; be kept free from worry, anxiety, strain, overwork, and mental excitement. She should rest in bed during the menstrual period; observe early hours, bathe regularly, and keep the skin and bowels active.[13]

A course of medicinal waters is good for many cases. All the alkaline waters are useful in curing uterine catarrh and leucorrhœa. The chloride-alkaline waters of Homburg, Aix-la-Chapelle, Kissingen, Taunus, and Roman Spa, may be drunk and used as a douche in uterine catarrh, leucorrhœa, endometritis, chronic metritis, and diseases of the uterine appendages and pelvic diseases generally. When there is marked anæmia the waters of Bath, Leamington, Harrogate, Flitwick, Pitkeathly, should be used, or those of Marienbad, Birmensdorf, Homburg, Wilhelmsquelle, Orezza, St. Moritz, and Pyrmont. If there are passive congestions, those of Carlsbad, Marienbad, or Tarasp.

Change of air is sometimes requisite, and may be taken at the respective watering-places above named. We may recommend a dry, bracing climate, like Malvern, Clifton, Bath, Matlock, Buxton, Ilkley, Harrogate, for females with passive congestions, anæmia, debility, neurasthenia, or other nervous troubles. A warm, dry climate, like Bournemouth, Brighton, Nice, Cannes, the Pyrenees, Pisa, Rome, Egypt, if there be copious secretions or uterine discharges and a relaxed state of the body; a warm, moist climate, like Falmouth, Penzance, Torquay, the Scilly Isles, Aberystwyth, South-West Ireland, Mentone, San Remo, Algeria, for very debilitated cases with little discharges.

The menopause, climacteric, or change of life, occupies about

five years: two or three from the commencement of irregularity to the cessation of functional activity, and a similar period during which the involution becomes complete and the normal activity of the body is re-established. If the health is carefully looked after during this period, the pathological conditions will subside, but negligence might result in a serious breakdown from nervous or other causes, which may end in permanent ill-health. Due care of the dietary, the functions of the skin, kidneys, and bowels, a careful mode of life, proper rest, freedom from worry and excitement, will end in the re-establishment of the health and formation of a *mens sana in corpore sano.*

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APPENDIX

I.—Standard Dietaries.

	Daily Requirement in Grammes.				
	Proteid.	Fat.	Carbo-hydrate.	Salts.	Calories.
Moleschott	130	84	404	30	2,970
Pettenkofer and Voit ...	137	117	352	30	3,113
Cornet	120	50	500	—	3,007
Ranke	100	100	240	—	2,324

	Daily Requirement in Ounces.			
	Proteid.	Fat.	Carbo-hydrate.	Total Food Water-free.
Moleschott	4·59	2·96	14·26	22·87
Parkes	4·5	3·5	14·00	23·00
Average of other authorities	3·5	3·0	14·00	20·50

The amount of energy required daily varies with the condition in life, and whether much or little muscular work is done. Energy and units of heat are expressed in calories. The number of calories required daily is stated by Atwater to be as follows :

Man doing	no muscular	work	requires	2,700	calories.
,,	light	,,	,,	3,000	,,
,,	moderate	,,	,,	3,500	,,
,,	severe	,,	,,	4,500	,,

Many authorities consider the latter figures to be higher than necessary—that 3,000 calories is enough under all ordinary circumstances, and 3,500 for severe work. The experiments of Chittenden prove that more proteid is provided than is necessary

in many standard dietaries; that with careful mastication and good digestion 50 per cent. of the amount of proteid stated by some writers is enough for ordinary work, as the energy is chiefly derived from carbohydrate.

Atwater's table is useful for calculating the amount of food required by individuals according to age. It is as follows:

The food of a	man is reckoned as	... ...	1·0
,, ,,	woman should be	... ...	0·8 that of a man.
,, ,,	boy 14 to 16 should be	... ...	0·8 ,,
,, ,,	girl 14 to 16 ,,	... ...	0·7 ,,
,, ,,	child 10 to 13 ,,	... ...	0·6 ,,
,, ,,	,, 6 to 9 ,,	... ...	0·5 ,,
,, ,,	,, 2 to 5 ,,	... ...	0·4 ,,
,, ,,	,, under 2 ,,	... ...	0·3 ,,

Metabolism is more active in children than in adults. Camerer states that at four years of age the energy used per kilogramme of body-weight is 91·3 calories; at twelve years 57·7 calories per kilogramme; at thirty years 42·4 calories per kilogramme. Hence a child of four years weighing 31 pounds requires enough food to yield 1,280 calories per day; a child of twelve years weighing 66 pounds about 1,730 calories; whereas a man of average size and weight requires 3,000 calories per day.

II.—The Fuel Value of Foods.

The digestibility and fuel value of proteid, carbohydrate, and fat, varies with their source, as shown by the following table:

Source.	Proteid.		Carbohydrate.		Fat.	
	Digested.	Calories.	Digested.	Calories.	Digested.	Calories.
	Per Cent.	Per Oz.	Per Cent.	Per Oz.	Per Cent.	Per Oz.
Total foods in mixed diet ...	92	114	97	114	95	253
Animal foods of mixed diet ...	97	121	98	108	95	253
Vegetable foods of mixed diet ...	84	90	97	114	90	237·5
Meat and fish ...	97	121·25	98	108	95	252·5
Eggs	97	123·75	98	108	95	255·6
Dairy produce ...	97	121·25	98	108	95	250·0
Cereals	85	109·37	98	116	90	237·5
Legumes, dried ...	78	97·00	97	115	90	237·5
Fruits	85	95·00	90	102	90	237·5
Vegetables ...	83	88·00	95	113	90	237·5

III.—The Calorie and Carbohydrate Value of Food.

In making calculations for dietaries, it is necessary to know the amount of heat and energy or number of calories which a given quantity of food will yield. It is also desirable in certain diseases to know approximately the amount of carbohydrate which the patient consumes. The following table is given as an aid for that purpose. In its compilation the analyses given in the text have been used; where the composition is not taken from the text it has been drawn from the analyses given in *Bulletin* 28, issued by the Agricultural Department of the United States, and from other sources. One ounce = 437·5 grains or 28·284 grammes; 1 gramme = 15·432 grains; 100 grammes = 3·53 ounces.

Nutrients in Food.

Food.	Parts per 100.			Grains per Ounce.			Calories per Ounce.
	Proteid.	Fat.	Carbo-hydrate.	Proteid.	Fat.	Carbo-hydrate.	
Cereals, etc.:							
Sugar, loaf or granulated	—	—	96·5	—	—	422	106
Molasses, sugar-cane ...	—	—	70·0	—	—	306	79
Maple syrup	—	—	71·4	—	—	343	86
Candy, plain sweets ...	—	—	96·0	—	—	420	104
Honey	0·4	—	75·0	1·7	—	328	82
Extract of malt... ...	6·39	—	70·0	37·0	—	306	89
Starch	—	—	90·0	—	—	394	102
Arrowroot	0·8	—	83·3	3·5	—	364	97
Wheat flour, high-grade	11·4	1·0	75·0	49·8	4·37	328	98
,, ,, low-grade	14·0	1·9	71·2	61·1	8·3	311	98
Entire wheat flour ...	13·8	1·9	71·9	60·3	8·3	314	103
Graham flour	13·3	2·2	71·4	58·1	8·7	312	103
Wheat breakfast food ...	12·1	1·8	75·2	52·8	7·8	328	105
White bread	6·8	0·7	52·3	30·7	3·0	228	68
,, ,, ...	8·0	0·9	50·0	34·9	3·9	218	68
Brown bread	5·4	1·8	47·1	23·5	7·8	206	64
Graham bread	8·9	1·8	52·1	38·9	7·8	228	75
Whole-wheat bread ...	9·7	0·9	49·7	42·3	3·9	217	70
Rolls, French	8·5	2·5	55·7	37·1	10·9	244	81
Sweet cake	6·3	9·0	63·0	27·5	39·3	275	101
Biscuit, crackers ...	11·3	10·5	70·5	49·3	45·8	308	118
Zwiebach	9·8	9·9	73·5	43·8	43·2	321	123
Rye meal	6·8	0·9	78·9	30·7	3·9	345	100
Rye bread	6·0	0·5	48·0	26·2	2·2	210	62
Corn meal, golden ...	14·0	3·8	70·6	61·1	16·6	308	105
,, ,, common ...	9·2	1·9	75·4	39·7	8·3	328	100
Hominy, cooked ...	2·2	0·2	17·8	9·6	0·8	78	23
Corn bread (Johnny-cake)	7·9	4·7	46·3	34·5	20·5	206	73

Nutrients in Food (continued).

Food.	Parts per 100. Proteid.	Parts per 100. Fat.	Parts per 100. Carbo-hydrate.	Grains per Ounce. Proteid.	Grains per Ounce. Fat.	Grains per Ounce. Carbo-hydrate.	Calories per Ounce.
Cereals, etc. (continued):							
Cornflour	7·1	1·3	78·4	31·0	5·6	343	103
Oatmeal	15·5	10·5	63·0	67·7	45·8	275	114
Rolled oats	12·6	7·2	64·0	55·0	35·0	280	106
Oat breakfast food ...	16·7	7·3	66·2	73·0	35·0	290	112
Oatmeal gruel (water)...	1·2	0·4	6·3	5·2	1·7	27	9
Buckwheat flour ...	6·4	1·2	77·9	28·0	5·2	340	100
Rice	5·0	0·8	83·2	21·8	3·5	362	102
Sago, tapioca	0·4	0·1	88·0	1·7	0·4	384	99
Vermicelli	10·9	2·0	72·0	47·6	8·6	315	102
Macaroni	13·4	0·9	74·1	59·0	3·9	324	103
Barley, pearl	8·5	1·1	77·8	37·1	4·8	340	103
Banana flour	3·5	1·5	81·6	15·2	6·5	365	90
Prepared cocoa	21·34	28·12	40·8	93·2	121·8	178	130
Puddings:							
Rice pudding	4·3	8·8	22·1	20·6	42·2	106	51
Tapioca pudding ...	4·16	7·3	16·7	20·0	35·0	81	43
Semolina pudding ...	4·63	9·3	15·7	21·2	44·6	76	47
Yorkshire pudding ...	5·8	7·5	13·4	27·8	36·0	67	35
Suet pudding	5·6	10·0	36·0	26·8	48·0	172	117
Blancmange	2·6	3·1	21·0	15·5	14·8	100	35
Dried Legumes:							
Haricot beans	18·0	1·7	60·0	78·6	7·4	262	92
Navy beans	22·5	1·5	59·6	98·3	6·5	261	96
Soya beans	41·0	13·0	30·0	189·0	62·0	130	116
Lentils	22·5	1·0	59·0	98·3	4·3	257	94
Peas	22·0	1·0	58·5	96·1	4·3	256	93
Pea meal...	27·5	1·3	56·7	120·0	5·8	248	95
Pea nuts	25·8	38·6	24·4	112·6	168·1	107	178
Ground nuts	21·8	51·7	17·6	103·4	226·0	77	170
Frijoles	21·9	1·3	65·1	96·0	5·8	285	106
Fresh Legumes:							
Green peas	6·06	0·5	14·03	26·4	2·2	61	21
Green beans	2·04	0·3	5·99	9·0	1·5	26	9
Butter beans	4·8	0·3	14·6	21·0	1·5	64	22
Shelled beans	7·1	0·5	25·0	15·0	2·2	110	32
Tubers and Roots:							
Potatoes	1·9	0·2	22·0	8·2	0·8	96	18
Sweet potatoes	1·5	0·6	26·0	6·5	2·6	114	31
Jerusalem artichokes ...	3·0	—	14·0	13·1	—	61	18
Parsnips	2·1	0·5	12·5	9·1	—	56	15
Carrots	1·0	0·2	10·1	4·3	0·8	48	13
Turnips	0·9	0·1	6·1	4·0	0·4	27	8

Nutrients in Food (continued)

Food.	Parts per 100. Proteid.	Parts per 100. Fat.	Parts per 100. Carbo-hydrate.	Grains per Ounce. Proteid.	Grains per Ounce. Fat.	Grains per Ounce. Carbo-hydrate.	Calories per Ounce.
Tubers and Roots (continued):							
Beetroot	1·3	0·04	18·6	5·6	0·1	81	22
Salsify	1·3	0·4	10·8	5·6	1·7	47	14
Radishes	0·9	0·1	4·0	4·0	0·4	17	5
Vegetables:							
Cabbage	1·8	0·2	5·0	7·8	0·8	22	7
Cauliflower	2·5	0·3	4·9	11·0	1·3	22	8
Brussels-sprouts	4·8	0·4	6·2	21·0	1·7	27	12
Spinach	3·1	0·5	3·5	13·5	2·1	15	8
Squash	0·7	0·2	4·5	3·0	0·8	20	6
Pumpkin and marrow ...	1·0	0·1	5·2	4·3	0·4	23	7
Asparagus	1·9	0·3	2·8	8·3	1·3	14	7
Tomatoes	0·9	0·4	4·0	4·0	1·7	17	5
Green corn (mealie) ...	3·1	1·1	19·7	13·5	4·8	87	27
Mushrooms	2·5	0·4	6·0	11·0	1·7	26	10
Truffles	8·9	0·6	7·5	38·8	2·6	33	19
Onions	1·5	0·1	10·9	6·5	4·8	47	16
Leeks	1·2	0·5	5·8	5·2	2·2	25	10
Celery	1·5	0·4	3·1	6·5	1·7	14	5
Lettuce	1·4	0·3	2·5	6·2	1·3	11	5
Cucumber	0·8	0·2	2·5	3·4	0·9	11	4
Watercress	4·2	0·5	6·5	18·3	2·2	30	12
Rhubarb	0·4	0·4	2·2	1·7	1·7	10	4
Canned tomato	1·2	0·2	4·0	5·2	0·8	16	5
,, green corn ...	2·8	1·2	19·6	12·2	5·2	86	27
,, baked beans ...	6·9	2·5	19·3	30·1	10·9	84	33
,, green peas ...	2·8	1·2	9·8	12·2	5·2	33	14
,, sucotash ...	3·6	1·0	18·6	15·7	4·3	81	26
Sauer-kraut	1·7	0·5	3·8	7·3	2·2	17	7
Fruit:							
Apples, average	0·4	0·5	12·5	1·7	2·2	55	15
Blenheim orange ...	0·4	0·3	15·5	1·7	1·3	68	18
Cooking apples	0·6	0·4	10·9	2·6	1·7	48	14
Pears	0·4	0·6	11·5	1·7	2·6	48	13
Plums	0·7	—	15·0	3·2	—	65	16
Greengages	0·4	—	13·5	1·7	—	59	15
Prunes, French	0·4	—	8·2	1·7	—	33	9
,, Californian ...	0·8	—	18·5	3·4	—	81	21
Apricots	0·5	—	11·0	2·2	—	48	13
Peaches	0·6	0·1	11·5	2·6	—	50	14
Nectarines	0·6	—	15·0	2·6	—	66	18
Olives	1·4	21·0	3·5	6·1	91·7	13	61
Cherries	0·7	0·8	11·1	3·0	3·8	48	14
Grapes	1·0	1·0	15·5	4·3	4·3	66	18
,, sweet	0 6	1·0	25·1	2·6	4·3	110	29

Nutrients in Food (continued).

Food.	Parts per 100. Proteid.	Fat.	Carbo-hydrate.	Grains per Ounce. Proteid.	Fat.	Carbo-hydrate.	Calories per Ounce.
Fruit (continued):							
Strawberries	1·1	0·5	6·5	4·7	2·2	29	8
Raspberries	0·5	—	5·5	2·2	—	24	6
Blackberries	0·9	2·0	6·0	4·0	8·6	26	12
Bilberries	0·7	—	5·8	3·0	—	25	7
Whortleberries	0·7	3·0	5·8	3·0	13·1	25	12
Mulberries	0·3	—	11·5	1·3	—	50	13
Black currants	0·4	—	7·9	1·7	—	34	9
Gooseberries	0·07	0·5	8·5	0·1	2·2	37	10
Cranberries	0·5	0·7	4·0	2·2	3·0	17	6
Melons	0·8	0·36	7·5	3·5	1·5	33	10
Water-melon	0·4	0·1	6·5	1·7	0·4	29	8
Pineapple	0·5	0·3	10·0	2·2	1·3	44	12
Bananas	1·5	0·6	21·0	6·5	2·6	92	25
Plantains	1·7	0·2	20·9	8·4	0·8	91	25
Oranges	0·9	0·5	7·6	4·0	2·2	36	11
Lemons	1·0	0·8	7·9	4·3	3·5	34	11
Dried apples	1·4	3·0	49·1	6·2	13·1	215	61
,, figs	5·5	0·9	65·0	24·0	4·0	284	78
,, prunes	2·5	0·8	66·1	11·0	3·5	289	76
,, dates	4·6	2·0	66·0	19·1	8·6	288	80
,, raisins	2·3	4·8	75·1	10·0	19·2	328	95
,, currants	1·4	2·9	64·9	6·0	12·6	284	79
Nuts, edible portion:							
Brazil nuts	15·3	65·0	7·4	66·8	284·0	32	163
Almond nuts	21·0	54·9	17·1	91·7	240·0	75	257
Filbert nuts	15·5	65·2	13·0	65·7	285·0	61	170
Walnuts	16·7	64·5	14·9	73·0	282·0	65	171
Butternuts	28·0	61·1	3·5	122·0	267·0	16	162
Chestnuts, fresh ...	6·2	5·5	42·2	27·0	24·0	185	63
,, dried ...	10·7	7·0	74·1	45·0	30·5	324	106
Cocoanut	5·7	50·5	27·7	25·0	218·0	120	145
,, shredded ...	6·4	57·2	31·9	28·0	251·0	150	169
Peccan nuts	11·0	71·2	13·2	48·0	311·0	58	180
Pistachio nuts	22·5	54·5	15·7	98·5	238·0	70	206
Lichi nuts	3·0	0·2	77·5	13·1	0·8	334	86
Peanuts, raw	25·7	28·6	24·2	102·5	125·0	107	110
,, roasted ...	30·5	49·2	16·2	132·2	215·0	71	152
Meat, edible portion:							
Beef, average	17·1	27·3	—	74·7	119·3	—	89
,, cooked	27·5	15·5	—	120·1	68·0	—	72
,, ribs, raw	13·9	21·2	—	60·7	92·6	—	71
,, sirloin, raw ...	16·5	16·2	—	72·1	70·7	—	61
,, rump, raw ...	13·8	20·2	—	60·3	88·3	—	68
Corned beef	14·3	23·8	—	62·4	104·0	—	78

Nutrients in Food (continued).

Food.	Parts per 100. Proteid.	Parts per 100. Fat.	Parts per 100. Carbo-hydrate.	Grains per Ounce. Proteid.	Grains per Ounce. Fat.	Grains per Ounce. Carbo-hydrate.	Calories per Ounce.
Meat, edible portion (continued):							
Pickled tongue	12·0	19·2	—	52·4	83·9	—	63
Salted or smoked beef ...	26·5	6·9	—	115·8	30·0	—	50
Veal, average	19·5	5·4	—	85·2	23·5	—	37
,, cutlets	20·1	7·5	—	87·8	32·7	—	43
Mutton, average ...	18·1	7·7	—	79·0	33·6	—	41
,, very fat ...	14·8	36·3		64·6	158·6	—	110
,, leg	15·1	14·7	—	66·0	64·1	—	56
,, ,, roast ...	25·0	22·6	—	109·2	98·7	—	91
Lamb, leg	16·0	13·6	—	70·0	59·4	—	54
,, breast	15·5	19·0	—	67·7	83·0	—	68
Venison	19·2	1·3	—	83·6	6·0	—	27
Pork, lean	19·9	6·8	—	87·0	30·0	—	41
,, fat...	14·5	37·3	—	63·3	164·0	—	112
,, loin chop... ...	13·4	24·2	—	58·5	106·0	—	78
Smoked bacon	9·1	62·2	—	36·7	272·0	—	169
,, ham	14·2	33·4	—	62·0	146·0	—	102
,, shoulder ...	13·0	26·6	—	57·0	116·0	—	84
Salt bacon, fat	1·9	86·2	—	8·2	377·0	—	222
Sausage, pork	13·0	44·2	—	57·0	193·0	—	129
,, German ...	18·2	19·7	—	79·5	86·5	—	72
Tripe	13·2	16·4	—	58·0	71·5	—	57
Brain	8·8	9·3	—	38·4	40·6	—	35
Liver*	22·5	4·2	2·5	98·3	18·3	11·0	38
Sweetbread	16·8	12·1	—	73·2	52·8	—	51
Kidney	16·6	4·8	0·4	73·2	20·9	1·7	32
Soup:							
Beef	4·4	0·4	1·1	19·2	1·7	4·9	7
Tomato	1·8	1·1	5·6	7·8	4·9	24·4	11
Gumbo, canned	2·4	0·2	4·6	10·5	0·8	20·0	10
Chicken ,, ...	2·9	3·3	5·1	12·6	14·5	22·2	15
Meat stew	4·6	4·3	5·5	20·0	18·7	24·0	23
Beef-tea	6·1	0·3	1·0	26·6	1·3	4·3	9
Pea soup	3·6	0·7	7·6	15·7	3·0	33·2	15
Oxtail soup	4·0	1·3	4·3	17·5	5·6	18·7	13
Mulligatawny soup ...	3·7	0·1	5·7	16·1	0·4	24·9	11
Turtle soup	6·1	1·9	3·9	26·6	8·3	17·0	17
Poultry, meat only:							
Fowls, chicken	22·7	10·1	—	99·0	47·0	—	63
,, capon	21·6	22·1	—	94·3	96·5	—	91
,, broiler	22·8	8·8	—	100·0	38·5	—	55
Pheasant...	24·7	4·6	—	108·0	20·0	—	51
Partridge	25·3	1·5	—	111·0	6·5	—	44
Turkey, light meat ...	25·7	9·4	—	112·0	41·0	—	67

* Liver may contain 13 per cent. carbohydrate, or 59 grains per ounce.

Nutrients in Food (continued).

Food.	Parts per 100. Proteid.	Fat.	Carbo-hydrate.	Grains per Ounce. Proteid.	Fat.	Carbo-hydrate.	Calories per Ounce.
Poultry, meat only (continued):							
Turkey, dark meat ...	21·4	20·6	—	94·0	90·0	—	90
Duck, breast	22·3	2·3	—	97·5	10·0	—	43
,, other meat ...	17·4	26·1	—	76·0	114·0	—	96
Goose	16·22	31·5	—	71·0	138·0	—	109
,, very fat	15·8	45·6	—	69·0	200·0	—	134
Pigeon	22·9	12·1	—	130·0	96·0	—	69
Quail	25·4	7·0	—	111·0	30·0	—	59
Squab, cormorant ...	18·5	23·8	—	81·0	104·0	—	92
Guinea-hen	23·4	6·5	—	102·0	28·5	—	50
Canned turkey	20·7	29·2	—	90·5	127·8	—	112
,, chicken... ...	27·7	12·8	—	121·0	56·0	—	78
,, quail	21·8	8·0	1·7	95·0	35·0	7·5	58
Potted turkey	17·2	22·0	—	75·0	96·0	—	87
,, chicken	19·4	20·3	—	85·0	89·0	—	87
Pâté de foie gras ...	13·6	38·2	—	58·6	167·0	—	130
Smoked goose	20·1	38·7	—	88·0	169·0	—	138
,, ,, without fat	26·1	4·5	—	114·0	20·0	—	53
Eggs, without shell:							
Hen's egg	13·5	11·6	—	58·0	51·0	—	46
,, white	13·1	0·1	—	57·0	0·4	—	15
,, yolk	15·5	31·7	—	68·0	139·0	—	100
Duck's egg	13·3	14·5	—	58·0	63·3	—	53
,, white ...	11·1	0·03	—	48·5	0·1	—	14
,, yolk... ...	16·8	36·2	—	74·0	158·0	—	115
Goose's egg	13·8	14·4	—	60·0	63·0	—	54
Turkey's egg	13·4	11·2	—	60·0	49·0	—	45
Plover's egg	10·7	11·7	—	47·0	51·0	—	44
Guinea-hen's egg ...	13·5	12·0	—	58·0	52·5	—	47
Evaporated hen's egg ...	46·7	36·0	—	204·0	158·0	—	164
Egg substitute	73·9	0·3	—	322·0	1·3	—	92
Dairy produce:							
Cow's milk	4·0	4·0	4·5	17·6	17·6	19·8	20
Skimmed milk	3·4	0·5	5·1	18·8	2·2	22·2	10
Buttermilk	3·8	1·2	3·3	16·6	5·2	14·5	11
Whey	1·2	—	4·5	5·2	—	19·6	6
Condensed milk, sweetened	10·0	10·5	51·3	43·7	44·5	224·0	93
,, unsweetened	9·8	10·8	14·3	43·0	47·0	62·5	54
Milk powder	90·0	—	—	394·0	—	—	106
Cream, medium... ...	2·5	18·0	4·5	10·9	78·6	19·6	50
,, rich	2·5	30·0	4·4	11·0	131·0	19·2	81
,, clotted	6·1	58·2	2·5	26·6	245·0	11·0	151
Butter	2·5	85·0	—	11·0	371·0	—	214

Nutrients in Food (continued).

Food.	Parts per 100. Proteid.	Fat.	Carbo-hydrate.	Grains per Ounce. Proteid.	Fat.	Carbo-hydrate.	Calories per Ounce.
airy produce (continued):							
Margarine	1·0	82·0	—	4·3	358·0	—	204
Cheese, Cheddar ...	26·7	30·5	—	117·0	131·0	—	117
,, American ...	30·8	27·7	—	134·6	121·0	—	106
,, Stilton	36·3	45·8	—	159·0	200·0	—	158
,, Gorgonzola ...	27·7	26·1	—	121·0	114·0	—	99
,, Rocquefort ...	28·3	30·3	—	124·0	132·0	—	110
,, Camembert ...	21·8	41·9	—	95·2	183·0	—	132
mphibia, etc., edible portion:							
Frog's legs	10·2	0·1	—	44·5	0·4	—	13
Terrapin	21·0	3·0	—	91·7	13·1	—	37
Green turtle	18·2	0·5	—	79·5	2·2	—	22
Lobster	18·1	1·1	0·6	79·0	4·8	2·6	25
Crab	15·8	1·5	0·8	69·0	6·5	3·5	23
Crayfish	16·0	0·8	0·8	70·0	3·5	3·5	23
Shrimps	25·4	1·0	0·2	111·0	4·3	0·8	32
Oysters	5·0	1·3	15·3	21·7	5·6	69·0	25
Clams, round	10·6	1·1	5·2	45·3	4·8	22·6	21
,, long	9·0	1·3	2·9	39·3	5·7	12·6	17
Scallops	14·7	0·2	3·4	64·2	0·8	14·8	22
Mussels	8·8	1·0	4·2	38·4	4·3	17·3	18
sh:							
Average of many kinds...	18·0	3·0	—	78·6	13·1	—	30
Fish-roe, shad	20·9	3·8	—	91·3	16·6	—	37
Caviare	30·0	19·7	—	131·0	86·0	—	95
Canned salmon	21·8	12·1	—	96·0	53·0	—	57
,, tunny	21·5	4·1	—	94·0	18·0	—	36
,, mackerel ...	19·9	8·7	—	87·0	38·0	—	46
,, haddock ...	21·8	2·3	—	96·0	10·0	—	31
,, sardines ...	24·0	12·1	—	105·0	53·0	—	60
Smoked or salted haddock	16·1	0·1	—	70·0	0·4	—	19
,, ,, halibut	19·1	14·1	—	84·0	61·0	—	60
,, ,, herring	20·5	8·8	—	90·0	38·0	—	47
,, ,, cod ...	16·0	0·4	—	70·0	1·7	—	20
esh fish, edible portion only:							
Alewife	19·7	4·9	—	86·0	21·0	—	42
Bass, sea	19·8	0·5		86·0	2·1	—	25
Black-fish	18·7	1·3	—	82·0	5·6	—	25
Blue-fish	19·4	1·2	—	85·0	5·2	—	26
Butter-fish	18·0	11·0	—	79·0	48·0	—	50
Catfish	14·4	20·6	—	63·0	90·0	—	71
Ciscoe	18·5	6·8	—	81·0	30·0	—	40

Nutrients in Food (continued).

Food.	Parts per 100.			Grains per Ounce.			Calories per Ounce.
	Proteid.	Fat.	Carbo-hydrate.	Proteid.	Fat.	Carbo-hydrate.	
Fresh fish, edible portion only (continued):							
Cod	16·5	0·4	–	72·0	1·7	—	20
Cusk	17·0	0·2	—	74·0	0·8	—	20
Eels	18·6	9·1	—	81·2	40·0	—	46
Flounder...	14·2	0·6	—	62·0	2·6	—	12
Haddock...	17·2	0·3	—	75·1	1·3	—	21
Hake	15·4	0·7	—	67·2	3·0	—	20
Halibut steaks	18·6	5·2	—	81·2	22·7	—	35
Herring	19·5	7·1	—	82·1	31·0	—	41
Kingfish	18·9	0·9	—	82·5	3·9	—	24
Lamprey...	15·0	13·3	—	65·5	59·1	—	53
Mackerel...	18·7	7·1	—	81·7	31·0	—	40
Mullet	19·5	4·6	—	85·2	20·1	—	35
Perch, white	19·3	4·0	—	84·3	17·5	—	33
,, yellow	18·7	0·8	—	81·7	3·4	—	24
Perch-pike	18·6	0·5	—	81·2	2·1	—	23
Pickerel-pike	18·7	0·5	—	81·7	2·1	—	23
Pike, gray	17·9	0·8	—	78·2	3·5	—	23
Pollock	21·6	0·8	—	94·2	3·5	—	27
Pompano...	18·8	7·5	—	82·1	32·7	—	41
Porgy	18·6	5·1	—	81·2	22·2	—	35
Red grouper	19·3	0·6	—	84·3	2·6	—	24
Red snapper	19·7	1·0	—	86·0	4·3	—	25
Salmon	22·0	12·8	—	96·1	57·0	—	60
,, sections... ...	17·8	17·8	—	77·7	77·7	—	67
Shad	18·8	9·5	—	82·1	41·5	—	47
Sheep's-head	20·1	3·7	—	87·8	16·1	—	33
Skate	18·2	1·4	—	79·5	6·1	—	25
Smelt	17·6	1·8	—	76·8	7·8	—	25
Sole, plaice	11·0	1·0	—	48·0	4·3	—	16
Sturgeon	18·1	1·9	—	79·1	8·3	—	26
Tom-cod	17·2	0·4	—	75·1	1·7	—	21
Trout, brook	19·2	2·1	—	83·5	9·1	—	28
,, lake or salmon ...	17·8	10·3	—	77·3	45·0	–	48
Turbot	14·8	14·4	—	64·6	62·9	—	55
Weakfish...	17·8	2·4	-	77·3	10·5	—	27
Whitefish	22·9	6·5	—	100·1	28·4	—	44

Combined with sugar and milk or cream in the usual proportions, 1 pint of tea will yield 145 calories, of coffee 195, of cocoa 210; and 1 pint of milk will yield 400 calories, of beef-tea 130, of beer 526, of port wine 971, of *dry* sherry 792; 1 ounce of pure alcohol will produce 198, of any spirit (50 per cent.) 99, of any spirit containing 35 per cent. 70 calories.

Three thousand calories would be produced by 42 ounces of cooked beef, 30 of ham, 14 of *fat* bacon, 26 of cheddar cheese; by $7\frac{1}{2}$ pints of cow's milk, 15 of skim milk, 6 of beer; 28 ounces of milk powder; 65 ounces of hen's eggs. The same amount would be produced by 28·3 ounces of sugar, $36\frac{1}{2}$ of honey, $33\frac{3}{4}$ extract of malt, 44 of white bread, 30 of sweet cake, $25\frac{1}{2}$ of biscuit or cracker, $28\frac{1}{2}$ of golden corn-meal, $26\frac{1}{2}$ of oatmeal, $29\frac{1}{2}$ of rice, 59 of rice pudding, $32\frac{1}{2}$ of haricot beans, $31\frac{1}{4}$ of navy beans, $32\frac{1}{2}$ of dried peas, $17\frac{3}{4}$ of ground-nuts, 17 of peanuts, 167 of potatoes, 97 of sweet potatoes, 111 of green corn, 120 of bananas or plantains, $37\frac{1}{2}$ of dried dates, 45 of dried raisins, 38 of dried currants, 38 of dried figs, 39 of dried prunes, $18\frac{1}{2}$ of dried brazil-nuts, $17\frac{1}{2}$ of dried filberts, $17\frac{1}{2}$ of dried walnuts, $28\frac{1}{2}$ of dried chestnuts; or $27\frac{1}{2}$ pounds of cabbage.

IV. The Salt-free Diet.

It has been established that a diet which is free from salt (*chloride of sodium*) is more conducive to the cure of certain conditions than one which contains the usual quantity of salt, especially in epilepsy and non-febrile serous effusions such as the late stage of pleurisy or dropsy. In these cases the food should not contain more than $1\frac{1}{2}$ grammes of salt per diem, which quantity it would be almost impossible to eliminate from the diet. Ordinary bread contains 5 to 7 grammes per pound, and milk about 1 gramme per pint.

When a salt-free diet is prescribed, *no salt must be used in making, cooking, or in eating any of the articles allowed.* The diet can be varied according to the disease, and may be selected from the following: Meat, fresh-water fish, eggs, milk, butter, cheese, cream, bread, potatoes, rice, peas, beans, carrots, celery, artichokes, salad; sugar, blanc-mange, custard, milk-puddings, sweatmeats; jelly, meat-jelly; and marjoram, thyme, parsley, bay-leaf, chutney or tomato sauce for flavouring; also mineral waters containing little NaCl, lemonade, tea, coffee, and beer or wine in small quantities. *Soup is forbidden*, as well as sea fish and all other articles which contain much salt. Carducci prescribed the following for dropsy: Milk $1\frac{1}{2}$ litres, meat 300 grammes, bread 300 grammes = 2,280 calories. The patient remained in bed until the œdema was quite gone, after which time the allowance of salt was raised to 3 grammes per diem, its elimination by the kidneys being watched. In epilepsy Bálint prescribed: Milk $1\frac{1}{2}$ to $2\frac{1}{2}$ pints, butter $1\frac{1}{2}$ ounces, three eggs, bread $9\frac{1}{2}$ to $12\frac{1}{2}$ ounces, and weak tea or coffee = 2,300 to to 2,400 calories per diem. This contained 2 grammes of salt, none being allowed in cooking or eating. It is believed that bromide acts more efficaciously when salt is withheld from the

food, and sometimes the salt is replaced by 45 grains of bromide of sodium in each day's allowance of bread. Such bread is called bromopan.

V. The Purin-free Diet.

Substances which contain the group C_5N_4 are called extractives or purins. The purins yield very little energy to the body, and are almost valueless as food. On the contrary, their excretion from the body is difficult, uric acid production is increased by foods containing them, and their presence is harmful in gout and allied diseases, epilepsy, renal and vascular disorders. The following foods *contain no purin*, and are recommended: Milk, butter, cheese, eggs, white bread, macaroni, rice, tapioca, cabbage, cauliflower, lettuce, sugar, fruit, sherry, port, volnay, and claret. Strictly speaking, milk and its derivatives contain traces of purin. Potatoes and onions contain very little purin, and are allowed. Tripe, cod-fish, neck of pork, pea-flour, and malted lentils contain rather more purin, but are often allowed. *Forbid* tea, coffee, cocoa, meat, fish, fowl, sweetbread, beans, asparagus, and malt liquors. The following table by Walker-Hall from the *British Medical Journal*, 1902, i., 1461, is useful:

The Quantity of Purins in Food.

Food.	Per Cent.	Grammes per Kilo.	Grains per Pound.	Food.	Per Cent.	Grammes per Kilo.	Grains per Pound.
Cod-fish ..	0·058	0·58	4·07	Sweetbread	1·006	10·06	70·43
Plaice ...	0·079	0·79	5·56	Chicken ...	0·129	1·29	9·06
Halibut ...	0·102	1·02	7·14	Turkey .	0·126	1·26	8·82
Salmon ...	0·116	1·16	8·15	Rabbit ...	0·097	0·97	6·31
Tripe ...	0·057	0·57	4·00	Oatmeal ...	0·053	0·53	3·45
Mutton ...	0·096	0·96	6·75	Peameal ...	0·039	0·39	2·54
Veal, loin ...	0·116	1·16	8·14	Haricot beans	0·063	0·63	4·16
Pork, loin ...	0·121	1·21	8·49	Potatoes ..	0·002	0·02	0·14
,, neck .	0·056	0·56	3·97	Onions ...	0·009	0·09	0·06
Ham (fat) ..	0·115	1·15	8·08	Asparagus ...	0·021	0·21	1·50
Beef, ribs ...	0·113	1·13	7·96	Lager beer ...	0·012	0·12	1·09
,, sirloin	0·130	1·30	9·13	Pale ale ...	0·011	0·14	1·27
,, steak ..	0·206	2·06	14·45	Porter ...	0·014	0·15	1·35
Liver ...	0·275	2·75	19·26				

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Climates and Health Resorts.

THE END.

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